

PRE- FEASIBILITY REPORT
(In terms of provision of EIA Notification 2006)
(Amendment in EC (under clause 7 (ii)) a of EIA notification 2006& its amendment)

For

**Expansion of Kayad Lead-Zinc Ore Underground Mine from 1.0 million
TPA to 1.2 million TPA (ROM)**

At

Kayad Mine, Village, Kayad, Ajmer District, Rajasthan



By

**Hindustan Zinc Limited
Rajasthan**

Submitted to

**Ministry of Environment, Forests and Climate Change (MoEF&CC)
New Delhi**

October-2017

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1. EXECUTIVE SUMMARY

- Hindustan Zinc Limited (HZL) is Asia's largest non-ferrous metal producer of Zinc and Lead and has Head office at Udaipur, Rajasthan. HZL is world's second largest integrated producer of Zinc with a global share of approximately 6.0%
- HZL has its operations in exploration, mining, ore processing, smelting and refining of Zinc, Lead, Cadmium, Copper and Silver. It is also a major producer of sulphuric acid, as a by-product of lead-zinc metal processing. HZL also has interest in wind and thermal power generation.
- The Kayad Lead Zinc Mine is located in District & Tehsil of Ajmer Tehsil of District Ajmer.
- Environment Clearance was granted by MoEF&CC, New Delhi for Enhancement in Production Capacity of Kayad Lead -Zinc Ore underground mine from 0.35 million TPA (ROM) to 1.0 million TPA (ROM) vide letter no. J-11015/47/2012-IA II(M) dated 23.09.2014. Presently Valid Consent to Operate is available from Rajasthan State Pollution Control Board (RSPCB), Jaipur for carrying Mining activities vide letter no. F(Mines)/Ajmer(Ajmer)/1(1)/2009-2010/7897-7901 dated 04.03.2015.
- The present proposal is for expansion of Lead – Zinc ore production from underground mine from 1.0 million TPA (ROM) to 1.2 million TPA (ROM). The Ore Produced at the Kayad Mine is sent to Rampura Agucha Mine for ore beneficiation in the existing mills having capacity of 6.5 MTPA capacity located in Hurda Tehsil, Bhilwara Dist of Rajasthan. The ore concentrate produced at Rampura Agucha Mine shall be processed at existing HZL Smelters.
- The Kayad village is 9 Km NNE of Ajmer city and is well connected by tar road. Jaipur, the state capital is 127 km NE of Mine. Nearest Airport is Kishangarh at 20 KM, NE of Mine. Although the nearest railway station is Madar (B.G.) at 6 km to the south of Kayad, the main railway station is at Ajmer on Ajmer-Kishangarh section of North Western Railway, 9 km SSE of Kayad. NH 79, Jaipur-Ajmer is at about half a km. from the lease area
- Kayad deposit is hosted by mid proterozoic Delhi Fold Belt of Metasediments (2000 my-750 my). Kayad Lies near the center of this 30 km wide belt in Ajmer Area . Mining Lease is demarcated on part plan of Survey of India Toposheet no. 45J/10. The deposit lies between latitude N 26° 31' 30" to N 26° 32' 30", longitude E 74° 41' 00" to E 74° 42' 00",

2.0 INTRODUCTION OF PROJECT

2.1 Identification of Project and Project Proponent:

2.1.1 Identification of Project

Zinc is a very versatile non-ferrous metal. Zinc's different applications rank it as the 4th most common metal in use after iron, aluminum and copper. In India, zinc demand growth continues to remain strong at about 8%, and is expected to leverage support from the automotive and the white goods sectors like galvanizing steel which protects from corrosion. Other major uses for Zinc include its utility in brass and bronze among many alloys; die casting, batteries, chemical compounds such as paints, ceramics, pharmaceuticals and fertilizers.

Over the medium term, growth in consumption is projected to average 5 per cent a year which is also likely to remain stable till Year 2025. Global zinc demand continues to be driven mainly by galvanizing sector in the emerging economies of Asia and Africa. The reported increase in Chinese manufacturing activities and US automotive sales along with emerging signs of stability in Europe's manufacturing and services sector are expected to support zinc demand.

The reason for expansion is that the ore produced at the Kayad Mine is sent to Rampura Agucha Mines for beneficiation in the existing mills of 6.5 MTPA capacities. Production from opencast mine at Rampura Agucha is now on a decreasing trend due to increasing pit depth. In order to increase the indigenous production of concentrates for captive smelters it is necessary to utilize the milling capacity of Rampura Agucha mine mill to full extent.

Ore production from Rampura Agucha underground mines is ramped up and the combined treatment of Rampura Agucha ore and Kayad ore will ensure the better utilization of the milling capacity.

The existing modified mining plan was approved by IBM which is valid upto year 2020-21. Nearly 10248 m of underground delineation drilling and 4970 m surface drilling was completed in the FY 16-17, the resultant change in configuration and redesign of mine methods leads to overall addition of 1.7 Mt reserves. The revised current exploration plan of FY 17-18 is in progress and 13831 m drilling has been completed upto 30-Sep-2017 which has enhanced the resource by 2.1 Mt. The exploratory drilling supported in further updation of the shape & geometry of the Ore body in the lower block where the most of the production will come during the planned period. The estimated reserve and resource is 9.74 Mt as on 1st Oct 2017.

In addition to the above, several positive intersections during the progressive exploration have indicated additional ore potential of Kayad Mines. Various satellite lenses have been identified both along strike and depth in addition to the easterly extension of the main lens. The eastern fringes of the main lens are further found to be extending for greater length. However the width of the ore is ~ 2-6 m with 4-7 % (Total metal content).

2.1.2 Project Proponent

Hindustan Zinc Limited (HZL) is the only integrated Lead & Zinc manufacturer in India and owns captive lead and zinc mines at Rampura Agucha, Rajpura Dariba, Kayad, Sindesar Khurd and Zawar Mines that cater to the requirement of lead and zinc concentrate for its smelters located at Chanderiya, Dariba & Debari. All the mining & smelting operations are based at Rajasthan.

2.2 Brief Description of Nature of Project

2.2.1 Nature of the Project

The project is a mechanised underground Lead-Zinc mine project and is classified as “**Category-A**” by Ministry of Environment & Forests, New Delhi as per EIA notification dated on 14th September 2006. The present proposal is for expansion of Lead – Zinc ore production from underground mine from 1.0 to 1.2 million TPA (ROM) (20% increase). Amendment in EC under clause 7 (ii) of EIA notification 2006, & subsequent amendments is applied.

2.2.2 Size of the Project

Kayad Mine deposit extends over a lease area of 480.45 ha with an estimated in situ ore reserves & resources as on 01.10.2017 is 9.74 Mt (1.17% Pb and 7.23% Zn). The proposed expansion of mine is from 1.0 to 1.2 million TPA of Lead-Zinc Ore Production (20% increase). Total cost of the proposed expansion is estimated to be Rs. 171 crores.

2.2.3 Location of the Project

The Kayad mine is 9 Km NNE of Ajmer city and is well connected by tar road. Jaipur, the state capital is at 127 Km of NE and nearest airport is Kishangarh at 20 km NE of the deposit. Although the nearest railway station is Madar (B.G.) at 6 km to the south of Kayad, the main railway station is at Ajmer on Ajmer-Kishangarh section of North Western Railway, 9 km SSE of Kayad. NH & 79 Jaipur-Ajmer is at about half a km. from the lease area. Mining Lease is demarcated on part plan of Survey of India Toposheet no. 45J/10. Kayad Deposit lies between Latitudes 26°31'41.47"N-26°31'37.04"N and Longitudes 74°41'30.73"E-74°41'30.45"E.

2.2.4 Mining Method

Mode of Entry: Decline

The mine access is comprised of single decline from surface portal (487.6 mRL) to the top of the orebody, at the 419 mRL where it then splits into separate North and South declines. The South decline will go up to 50 mRL and North Decline will go up to 150 mRL. The declines are designed at a gradient of 1 in 7.

Development and Stopping method

Currently, the Underground mining method used in Kayad mine is Long Hole Open Stopping. After mining, every open stope is filled by Rock fill or Cemented Rock fill.

Longitudinal Long hole open stopping (LHOS) method is proposed for the steeper portion up to 225 mRL and Long Hole Open Transverse stopping is proposed for the shallow (almost flat) portion of ore body below 225 mRL. The upper, steep dipping section of the orebody is accessed via a central level access from each decline which connects to longitudinal (along strike) north and south ore drives. Stopes are mined in a retreat sequence back to the central access. The lower, flat lying section of the orebody is accessed via footwall drives developed north and south from the decline accesses, along the strike extent of the orebody. Transverse drives provide access to the stopes from the footwall drives.

Mine Development in Block I and II is completed for main lens and Block III is currently being developed. In Block III wherever ore body is steeper Longitudinal Open Stopping Method is proposed. All the mining is planned with back filling with Rock fill (RF) and Cemented rock fill (CRF). Other Mining Methods such as Drift and fill method may be considered wherever orebody configuration requires.

Ore body is being accessed by developing ore drives of 5 m x 4.5 m (WxH) in dimension from all these main levels. The decline of 5.5m x 5m (WxH) in dimension is serving the purpose of hauling of waste and ore up to surface. In addition, the decline also serves as man, material & ventilation intake to the mine. Decline is also used for the to-and-fro transport of all heavy earth moving and drilling equipment. The second egress to the mine is provided in ventilation raise of 3.5m dia. at North of the mine.

Production drilling is planned from both the drill level. Rings shall be drilled from slot to FW contact of orebody using Simba/Solo/ITH drill machine covering the geometry of the stope.

Three main mechanical ventilators of 150 Cum/sec (450 KW) capacity are installed at bottom of South ventilation raise (3.5m diameter circular) at 400 mRL, North ventilation raise (3.5m diameter circular) at 375 mRL and Central ventilation raise (3.5m diameter circular) at 250 mRL. The fans serve as the main exhaust for both sections. Fresh air enters through main decline (130 Cum/sec) and through North surface ventilation intake raise (50 Cum/sec) and South surface ventilation intake raise (50 Cum/sec).

The blasted muck from stope is then withdrawn at extraction level through LHDs and then directly loaded in to mine trucks for hauling through ramps from underground to surface stock yard. From stock yard, ore is dispatched to Rampura Agucha Mine for further processing.

While blasting in stopes, each ring in the stope will be blasted with multiple delays, so that the blast vibrations are kept within the safe limits. Care shall be taken to maintain through proper hole measurement, charge length, stemming and adequate delay in holes. Adequate numbers of detonators shall be used to keep the charge per delay in permissible limit and each blast vibration and sound will be monitored by CIMFR, Dhanbad.

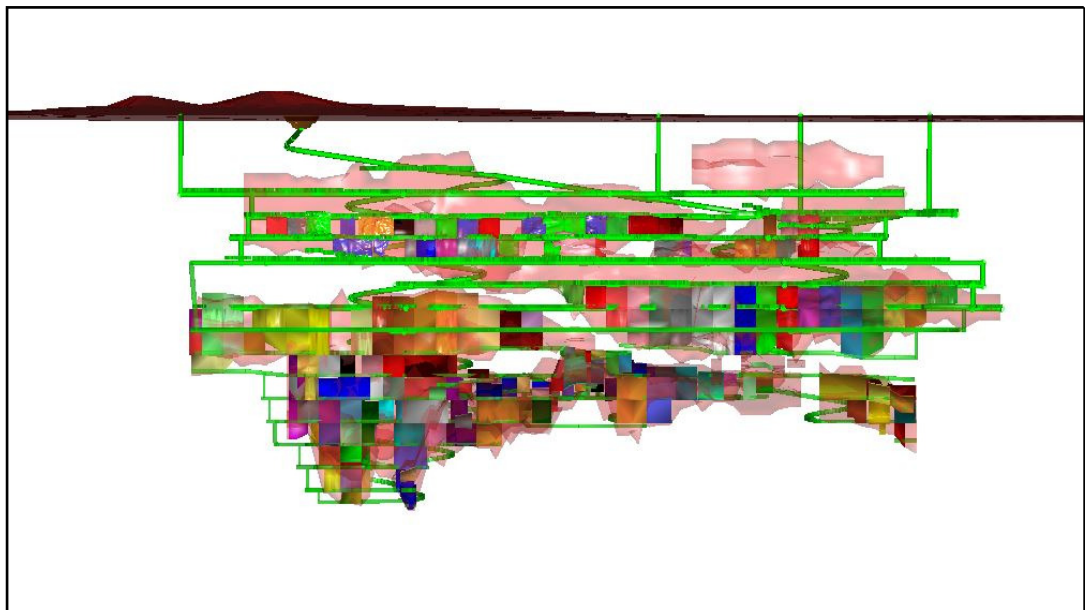


Fig 4: LVS showing Mine workings

2.2.5 Importance to the Country & Region

Enhancing the production capacity of this Lead-Zinc deposit is important for the country's long-term economic growth and increased revenue earnings. This will transform the region's economy from predominantly agricultural to significantly industrial, and accelerate the pace of industrial development in the region.

2.2.6 Supply and Demand Details

In the aftermath of the Great Financial Crisis of 2008-2009, the Indian economy lost momentum. Growth in industrial production slowed from an average of 7.9% during 2000-2008 to 3.9% over the period 2010-2015.

The rising trend of Indian economy has increased growth and also the continuing boom in manufacturing and in steel production coupled with the growth in automobile industries and infrastructure in particular has raised demand for lead and zinc metals considerably.

2.3 Need for the Project and its Importance to the Country & Region

Zinc is a very versatile non-ferrous metal. Zinc's different applications rank it as the 4th most common metal in use after iron, aluminum and copper. Global zinc consumption is forecast to grow at a compound average annual rate of 2.4% p.a. over the period 2016-2021. Global zinc consumption is projected to grow to 20Mt in 2035 representing an average annual increase of 0.28Mt.

Consumption growth sets a requirement for extra raw material supply to smelters (concentrate and secondary materials) of 0.28Mt/a Zn. Whilst some of the extra mine capacity will come from expansions and mine life extensions of existing producers, the majority will be from new mines. HZL's largest producer Rampura Agucha openpit mine is in closure stage, so by mining this deposit, HZL will provide the country with increased revenue earnings. This will also transform the region's economy..

2.4 Import Vs Indigenous Production

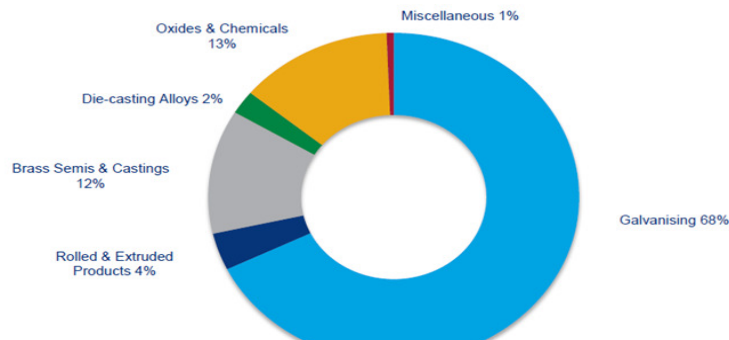
The present production capacities of Zinc in India are sufficient to meet the domestic requirements. However, the demand for zinc in India is expected to grow at a rate of 8% which makes it viable for the expansion of the zinc production capacities. Further the deficit in international market during the upcoming years provides opportunity for export.

2.5 Export Possibility

Indian exports majorly catered to South East Asian and African nations. In India, since, Hindustan Zinc is the largest producer of primary zinc, export of zinc is highly feasible and shall bring value addition.

2.6 Domestic/Export Market

Zinc having found primary application in galvanization, a range of galvanized products are produced to meet various industrial and consumer demands. Galvanized sheets (corrugated and plain), galvanized pipes, galvanized structures, galvanized sheet, galvanized wires are used for various applications. Galvanizing Segment accounts for 68% share of the overall zinc demand in India while Non-Galvanizing accounts for 32% share. Among the major customer segments, Galvanized Sheets accounts for major share of the zinc consumption followed by structures and Alloys. The following chart explains the demand for zinc in India and its segment wise break-up



(Source: Wood Mackenzie Long Term Outlook)

India has the potential for exporting zinc profitably as global zinc demand continues to be high & driven mainly by galvanizing sector in the emerging economies of Asia and Africa. The reported increase in Chinese manufacturing activities and US automotive sales along with emerging signs of stability in Europe's manufacturing and services sector are expected to support zinc demand

2.7 Employment Generation (Direct & Indirect)

The existing operation has direct employment of about 629 persons and the proposed project will be managed by the existing resources but there is an ample opportunity for increase in indirect employment due to mining related activities like transport, small workshops, garages, and due to development of local area.

3.0 PROJECT DESCRIPTION

3.1 Type of Project

The proposed project is a mechanized underground lead-zinc mining brownfield project involving 20% increase in ore production i.e from 1.0 to 1.2 million TPA (ROM).

3.2 Location

The Kayad village is 9 Km NNE of Ajmer city and is well connected by tar road. Jaipur, the state capital and nearest airport is 127 km NE of the deposit. Although the nearest railway station is Madar (B.G.) at 6 km to the south of Kayad, the main railway station is at Ajmer on Ajmer-Kishangarh section of North Western Railway, 9 km SSE of Kayad. NH 8 Jaipur-Ajmer is at about half a km.

Kayad deposit is hosted by mid proterozoic Delhi Fold Belt of Metasediments (2000 my-750 my). Kayad Lies near the center of this 30 km wide belt in Ajmer Area. Mining Lease is demarcated on part plan of Survey of India Toposheet no. 45J/10. It lies between Latitudes 26°31'41.47"N-26°31'37.04"N and Longitudes 74°41'30.73"E-74°41'30.45"E.

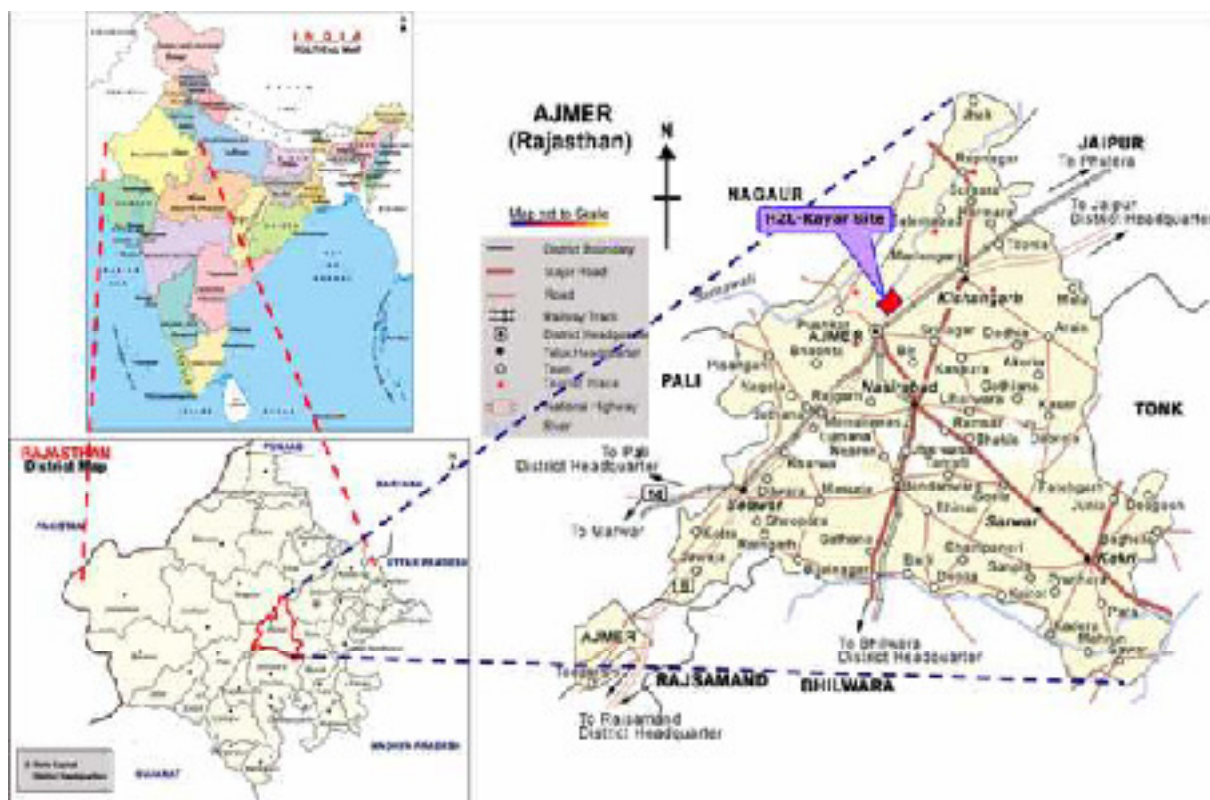


Fig No. 1: Location map of Kayad mine

3.3 Alternate Sites Considered

No alternate site is applicable since it is a brown field expansion of underground mine.

3.4 Size of Operation

The project has been planned to produce 1.2million TPA(ROM) Lead - Zinc Ore production from the underground mine by expanding from the present 1.0 million TPA ore production (20% increase). The salient features of the proposed project are given in Table 3.2

3.5 Project description with Process details:

**TABLE-3.2
SALIENT FEATURES OF THE PROJECT**

S. No.	Description	Existing	Proposed
1.	Mine lease area	480.45 ha	No Change
2.	Land Requirement	48.5 ha	No Change
3.	Ore mineral	Lead ,Zinc and associated Mineral	
4.	Established Depth	About 437 m	About 437 m
5.	Reserves & Resources	9.74 million tons, 7.23% Zn, 1.17%Pb as on 01.10.2017	
6.	Mode of Entry	By a ramp Decline	No change
7.	Method of Mining	LHOS, TOS, Drift and fill with waste rock	No change
8.	Ore Production	1.0 million TPA	1.2 million TPA (20% increase)
9.	Ore Beneficiation	Nil	Nil

10.	Waste Rock Generation (2017-18 to 2020-21)	5,95,000 MT	8,55,000 MT*
11.	Waste dump area	1.0 Ha	No change
12.	Power requirement & Source	5.0 MW, AVVNL & Emergency 1.0 MW DG set	No change
13.	Water requirement & Source	560 m ³ /day, (PHED+ STP+ Mine Dewatering)	No change
14.	Manpower requirement (Nos.)	629	No Change
15	Project Cost	Rs. 350 crores	Rs. 171 Crores (Additional)
16	Environment Protection Cost	Rs. 4.3 crores	Rs. 17 Crores

* In the proposed expansion of Kayad Mine, no additional waste will be dumped on the surface beyond the already approved waste quantity and hence no additional waste dump is envisaged. The increased waste generated will be disposed off into the underground voids. Additional waste required for backfilling will be utilised from Rampura Agucha Mine.

3.5.1 Mine Description&Introduction:

Kayad deposit is hosted by mid proterozoic Delhi Fold Belt of Metasediments (2000 my-750 my).Kayad Lies near the center of this 30 km wide belt in Ajmer Area. Mining Lease is demarcated on part plan of Survey of India Toposheet no. 45J/10. Kayad Deposit lies between Latitudes 26°31'41.47"N-26°31'37.04"N and Longitudes 74°41'30.73"E-74°41'30.45"E.The area is undulating with altitude varying from 486-568 506 MSL. The highest point is at 568506 MSL. The area is mostly soil covered with weathered rock. No prominent landmark is present within project site.

3.5.2 Geology

3.5.2.1 Topography

The area is undulating with altitude varying from 480 to 506 mRL. The highest point is a small hillock just east of the village Kayad, attaining an altitude of 506 mRL. The area is mostly soil covered with a few outcrops here and there. The seasonal "Kala Nala" (outside the ML) flowing from south to north joins Phool Sagar reservoir near Kayad village. The drainage is a seasonal and is mostly of dendritic pattern and there is no watercourse other than seasonal "Kala Nala" in the area. A number of dug well with water table varying between 20 to 30 m are present.

The Kayad village falls on the western end of lease boundary. The topsoil is fertile and suitable for agriculture. Seasonal crops are jawar, maize, bazra and other cereals etc.

3.5.2.2 Regional Geology

Kayad deposit is hosted by mid proterozoic Delhi Fold Belt of metasediments (2000 my-750 my). Kayad lies near the centre of this 30 km wide belt in Ajmer area. While a major Kaliguman lineament forms the boundary of Delhi supergroup with Sandmata / Mangalwar complex in the east, Marwar Supergroup lithology bounds this in the west.

The rocks are assumed to have been deposited in a shelf margin to a shelf interior environment. Later orogenesis with magmatism concomitant contributed a significant change in the overall setup and morphotectonic features.

Table: Summarized Geological Succession

Group	Sub Group	Formation	Litho units
Ajabgarh Group	Arauli	Ajmer Formation	Carbonaceous Phyllite, Garnetiferous, Chlorite schist
	Barkhol		Carbonaceous Phyllite and Quartzite
	Thanagazi		Phyllite, Felsic volcanic rocks
	Sariska		Quartzite, Phyllite and Marble
	Kushalgarh		Siliceous Schist, Marble bands and dolomite rich bands.

Structure

The general strike of litho units exposed in the Kayad and its surrounding area is NNE-SSW to NE-SW parallel to regional trend of central axis of main "Delhi Synclinorium". An open fold structure with shallow north easterly plunging hinge has been revealed after the detailed studies of the recent oriented core drilling over the deposit. The contact of quartz mica schist and calc silicate is a folded one. Hinge of the fold strikes in N25E-S25W direction. While one limb is dipping about 60°-70° due SE, the other one is flatter with dips ranging from 10° to 40° due SE.

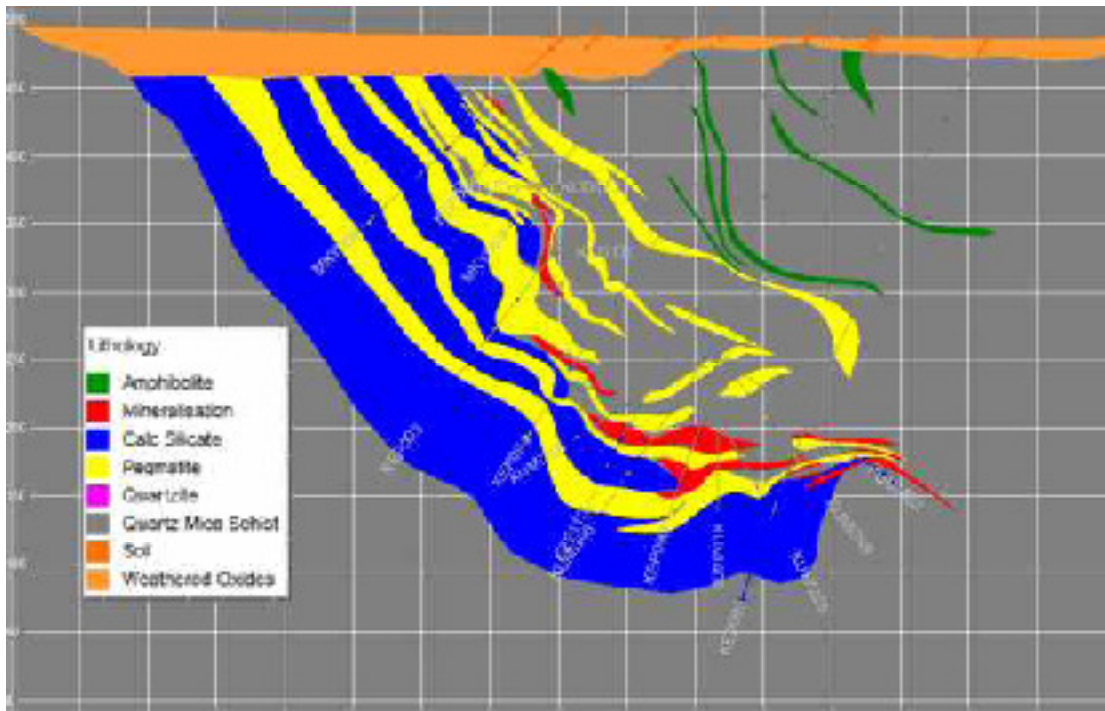
The primary bedding is well preserved in the form of color and compositional banding represented by bands of ferruginous, siliceous and carbonates material in the calc-silicate exposed on the mound east of Kayad village. Foliation in the schist is parallel to axial plane of F2 fold and is dominant secondary structure recorded in the area. The foliations are often seen crenulated in the schist due to later deformation and shearing.

Joints are seen in the quartzite, quartz mica schist, Calc-silicate and rarely in the migmatites and gneisses. The common trends are E-W with vertical dips and NNE-SSW having steep dips of 70 to 80 degrees due east or west.

Mineralization

In the mineralised zone grains of sphalerite, galena and pyrrhotite show effect of shearing in the form of brecciation and mylonitisation. Number of small sympathetic to tangential shears and fracture planes of varying width is encountered in the boreholes. The main host rock is Quartz mica schist with some mineralization also occurring in calc silicate.

Typical Geological Section showing different lithology



3.5.2.3 Geology of the Deposit

Kayad is a mostly flat soil covered area except a mound of Calc silicate rock (with Amphibolites and Pegmatite intrusions) situated to the west of the deposit. Few isolated out crops of hard and resistant Migmatites are also seen further west of leasehold in the ground. In general, Meta-sedimentary formations from East to West are the host Quartz Mica Schist (QMS), Calc silicate rock (CSR) and Quartzite.

Lead zinc mineralisation occurs mainly at the interface of Quartz Mica Schist and CalcSilicate with the earlier rock seeming to be the main host rock.

i. Shape and size of the mineral/ore deposit

There are three major lenses – the Main lens, K1 lens and S1 lens and two minor lens namely S2 & NEML. The main host rock is Quartz mica schist with some mineralization also occurring in calc silicate. Main lens has been dissected at many places by pegmatite. The lenses lie parallel to the axial plane foliation/ cleavage/ fracture of the fold system or shear fractures governed by the lithological variations. The main lens has been explored to variable depths and maximum upto 50 mRL while K1 and S1 goes upto 375 & 150 mRL respectively.

The main lens ranges in average width from 5 m in steeper portions to about 35 m in the flat lying portion. Maximum strike of the main lens is 900 m at the depth of approx 250 m from the surface.

It shows a general reducing trend in depth. This lens shows swelling and pinching nature probably because of superimposition of different phases of folding.

K1 lens has strike of 250 m and the average width of 4 m. This is comparatively a richer lens as far as the metal content is concerned. The exploration during 2011-12 has delineated a minor lens (S1 lens) on the southern side of the main lens which has strike of 150m and the average width of 3m.

S2 lens is a low grade resource lying at distance of 600m from the southern margin of main lens. The average width is 2-5m with strike length of 650m at a depth between 200mRL to -150mRL. The Mineralization occurs in calc silicate rock and is disseminated in nature.

NEML lens is at a distance of 500m from eastern margin of main lens. The average width is 3-7m with strike length of 350m and lies at a depth between 0mRL to -280mRL. The Mineralization occurs predominantly in quartz mica schist along with calc silicate rock. The physical parameters of these lenses have been tabulated below in table no 10.

Table No. 13
Description of Ore body Lenses

<i>Lens</i>	<i>Strike Length (m)</i>		<i>Avg- width (m)</i>	<i>Depth from (mRL)</i>	<i>Depth to (mRL)</i>
Main Lens	Steeper Portion	900	5 – 15	450	230
	Shallow Portion	800	15 – 35	225	50
K1 Lens		250	4	470	375
South (S1) Lens		150	3	450	150
South (S2) Lens		650	2 – 5	200	-150
NEML Lens		350	3-7	0	-233

ii. Disposition of various ore lenses-

The disposition of various lenses is shown in the perspective view below

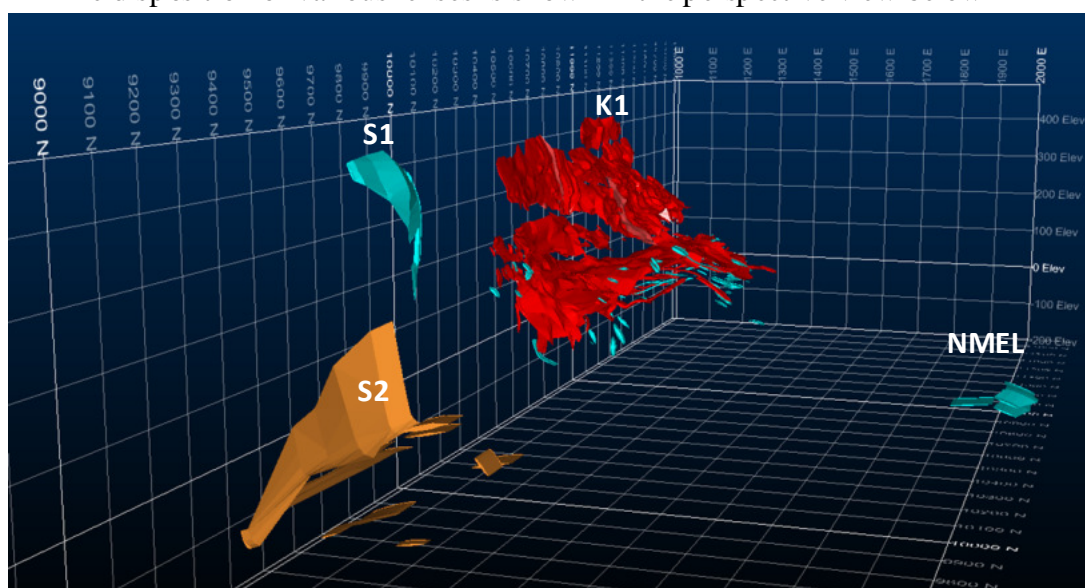


Fig. No. 2: 3D View of different Ore Lenses.

iii. Lithology:

- 1. Quartz Mica Schist:** This rock unit is seen mostly in drill core and is rarely exposed in the area. The rock is dark gray to grayish black, fine to medium grained showing schistose texture. It is composed of biotite, muscovite, quartz and feldspar with garnet, rutile, zircon occurring as accessory minerals.
- 2. CalcSilcate:** This is grayish white in color, sometimes showing color and compositional banding of white layers of carbonates and greenish gray to dark brown layers of mafic minerals.
- 3. Quartzite:** It is found in the western parts of lease. The rock is light gray, hard and compact. It is predominantly composed of quartz.
- 4. Pegmatite:** This is an intrusive rock composed mostly of quartz and feldspar, coarse to medium grained. This has intruded and dissected the mineralization in the depth.
- 5. Amphibolite:** It is mostly seen in the drill core having concordant relationship with the enclosing rocks. The rock is green in colour, fine to medium grained, massive to foliated in nature. It is mostly composed of hornblende, quartz and feldspar with or without garnets.

iv. Structure:

The general strike of litho units exposed in the Kayad and its surrounding area is NNE-SSW to NE-SW parallel to regional trend of central axis of main "Delhi Syndinorium". An open fold structure with shallow north easterly plunging hinge has been revealed after the detailed studies of the recent oriented core drilling over the deposit. The contact of quartz mica schist and calc silicate is a folded one. Hinge of the fold strikes in N25E-S25W direction. While one limb is dipping about 600-700 due SE, the other one is flatter with dips ranging from 100 to 400 due SE.

The primary bedding is well preserved in the form of color and compositional banding represented by bands of ferruginous, siliceous and carbonates material in the calc-silicate exposed on the mound east of Kayad village. Foliation in the schist is parallel to axial plane of F2 fold and is dominant secondary structure recorded in the area. The foliations are often seen crenulated in the schist due to later deformation and shearing.

Joints are seen in the quartzite, quartz mica schist, Calc-silicate and rarely in the migmatites and gneisses. The common trends are E-W with vertical dips and NNE-SSW having steep dips of 70 to 80 degrees due east or west.

Based on the drilling data and mapping of limited surface outcrops of lithounits it is observed that a major shear zone trending N-S to NNE-SSW is passing through the area near the contact of calc-silicate and quartz mica schist along which major pegmatite bodies have probably been emplaced. This zone is 40 to 100m wide and quartz mica schist show mylonitisation, brecciation and retrograde alteration of muscovite to sericite.

In the mineralised zone grains of sphalerite, galena and pyrrhotite show effect of shearing in the form of brecciation and mylonitisation. Number of small sympathetic to tangential shears and fracture planes of varying width is encountered in the boreholes. In general these shear planes depending upon their spatial orientation are either at high angle to the core axis or are parallel to sub parallel in nature.

v. Mineralogy

The main ore minerals are sphalerite and galena. Chalcopryite occurs in minor proportions mostly on footwall of the orebody. Other sulphides like pyrrhotite and some pyrite also constitutes the assemblage. The sulphides occur as discontinuous veins, massive bands, fracture fillings, and occasionally as disseminations. Sphalerite is coarse to medium grained.

Galena occurs as medium grained inclusions, patches and small stringers within sphalerite and pyrrhotite. Chalcopryite is observed as fracture fillings within pyrrhotite and occasionally in sphalerite. Quartz, biotite, muscovite, feldspar with occasional Amphiboles (hornblende) and garnet are main gangue minerals.

3.5.2.4 Exploration:

Exploration at Kayad commenced in 1967 when Geological Survey Of India (GSI) carried out multisensory airborne geophysical Survey in some parts of Rajasthan and other states under (OHR) Operation Hard Rock.

Two anomalies were picked in Kayad and Ghugra area near Ajmer. After geological mapping and geochemical survey to ascertain the causative source of a geo physical anomaly, drilling in the anomalous geochemical anomaly zone led to the discovery of this deposit in 1988. GSI drilled 3179 m in 14 holes at 200 m spacing from 1988-91. A total 7.5 million tons of lead-zinc ore resource with 1.20% lead and 12.0% zinc was estimated by GSI.

In view of potentiality of the prospect, Mineral Exploration Corporation Ltd., (MECL) formulated an integrated scheme of exploration involving 7650 meters of drilling in 42 boreholes, bench scale beneficiation test and base line environment survey. MECL drilled 9584.90m in 42 holes (1994-97) on promotional basis and estimated 10 million tons of reserves grading 2.67%Pb and 14.89% Zn over a strike of 1 Km and vertical depth of 250m.

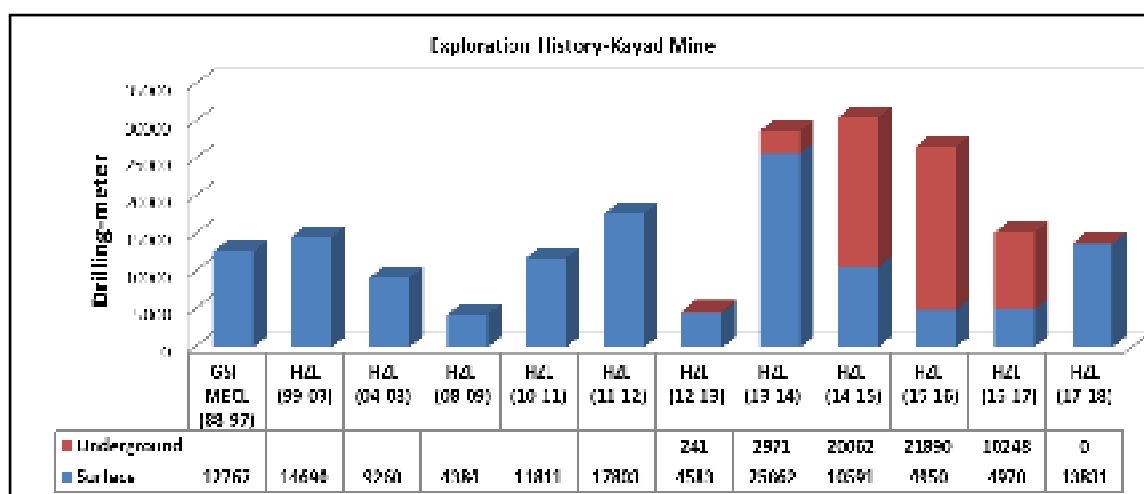
Evaluation of MECL data revealed significant exploration gaps and presence of pegmatite intrusions in host rock and had considerable impact on the continuity of orebody in strike and dip. Hindustan Zinc Limited (HZL) planned the exploration with an objective of delineation of the deposit by filling the gaps, establish firm geological, metallurgical and geotechnical parameters for conceptual mine planning and preparation of feasibility report.

HZL acquired the Mining Lease of the deposit in February 1998 and started systematic Exploration in different phases with advanced geological and geophysical techniques. HZL has drilled 123911 m surface drilling in 292 bore holes till September17. From October 2010 to March 2017 extensive drilling (55412 m drilling in 826 bore holes) carried out from underground to rectify the discrepancies noticed in shape and size of ore body.

Underground drilling started in 2012-13 and is still under progress. Multiple holes were drilled from each section in fan shape manner to define the ore body below 325mRL at regular interval of 12.5m along dip direction from 325mRL and 250 mRL HW exploratory drives.

Thus the cumulative drilling stands at 192090 m in 1175 holes completed in phases. This has resulted in the increase in resource & better delineation of ore lenses both in strike and depth.

The year on year exploration has been shown in the graph below:-



*Drilling updated upto 30th Sept. 2017.

Table: Status of Reserve & Resources as on 01.10.2017

Category	UNFC	Million Tonnes	Zn %	Pb %	Ag g/t
A. Mineral Reserve					
1. Proved Mineral Reserve	111	2.00	7.30	1.00	28
2. Probable Mineral Reserve	121 and 122	5.03	8.24	1.22	30
Total Reserve		7.03	7.97	1.16	30
B. Mineral Resources(A+B)					
1. Measured Mineral Resource	331	-	-	-	-
2. Indicated Mineral Resource	332	0.50	7.58	1.22	19
3. Inferred Mineral Resource	333	2.21	4.80	1.20	17
4. Reconnaissance Mineral Resource	334	-	-	-	-
Total Resources		2.71	5.31	1.20	17
Total (Reserve & Resources)(A+B)		9.74	7.23	1.17	26

3.5.3 Mining

3.5.3.1 Method of Mining:

A. Longitudinal Long Hole Open Stopping (LHOS):

For Longitudinal Long hole open stopping method, the stope size planned is 25m height, 25 –50m length (along strike) depending upon the geometry of the ore body and geotechnical Consideration.

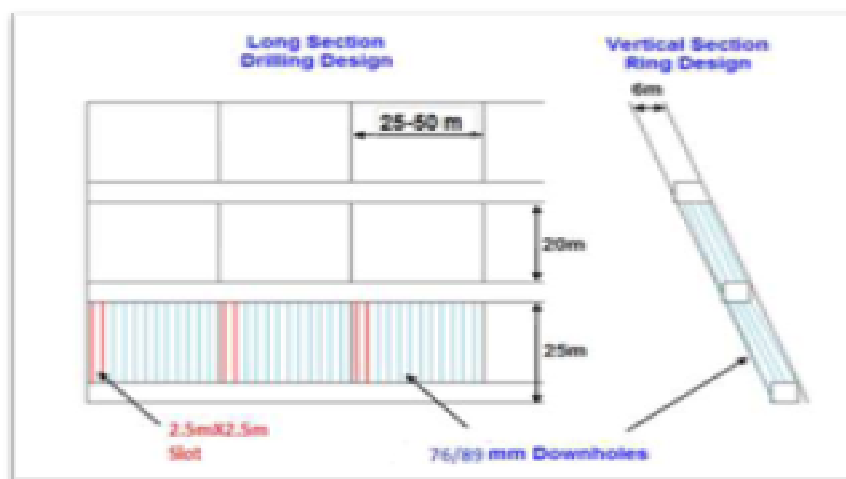


Fig : Typical Longitudinal LHOS

B. Transverse Long Hole Open Stoping (LHOS):

The stopes are planned across the strike in transverse direction with individual stopes of 10-25m height, 15 m width and length of stope equal to width of ore body. All primary stopes will be back filled with CRF only and Secondary stopes will be back filled with CRF and RF combination.

In both mining methods, production drilling is carried out from level drives below supported roof and mucking through drives and cross cuts below solid roof which eliminates exposure to potential rock falls.

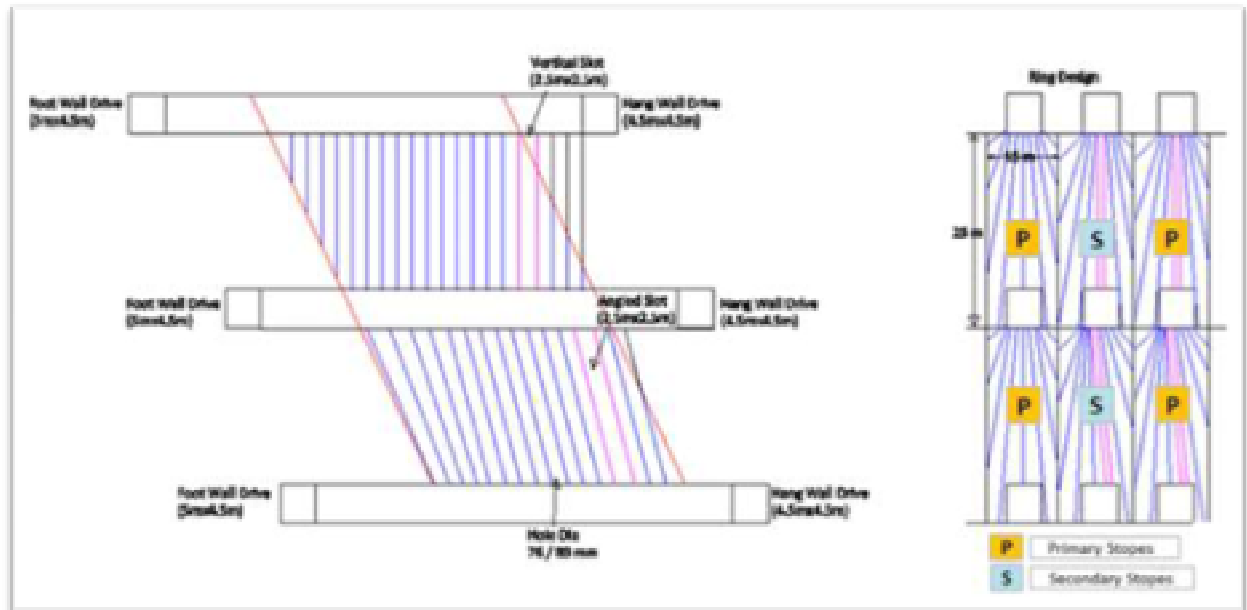


Fig : Typical Transverse stope

3.5.3.3 Conceptual Mine Plan

Planned production from Kayad mine had been increased to 1.0 million TPA as per approved Mining Plan dated 07/08.05.13 and EC terms dated 23.09.14. The mine has now reached to a sustained level of production at the designed rate 1.0Mt per annum. Before embarking on to the details of mining it is necessary to discuss briefly the conceptual plan, hereunder.

The ore body at Kayad comprises of discontinuous veins, fracture fillings and occasional disseminations of the sulphides. The true width of orebody is varying from 5 m (in the steeper portion) to 50 m (in the shallow areas).

From the ore reserves and mineral resources summary as on 01.10.2017 estimated reserves and resources of Kayad mine stands at 9.74 Mt (1.17% Pb, 7.23% Zn). For a 1.2 Mt per annum of production, the life of the mine as per existing reserve comes to approximately 6 years. Apart from this potential of 2.21Mt of resources is established by exploration which is still continued. Considering past exploration results, the additional resources will be converted to reserves to enhance the life of mine.

Presently, the mine is being worked at 180 mRL and by the end of the 4th year of the Modified Mining plan the mine workings are expected to reach 50mRL. Exploratory drilling is

being carried out from surface and underground, for proving the further depth extension of ore body below 50 mRL. With exploration effort the reserve and resource of Kayad deposit is expected to increase in due course of time.

Based on the current reserve and resource of Kayad deposit it is, technically feasible to achieve ore production rate of 1.2Mt per annum as per the mining plan.

Kayad deeper level exploration is under progress and there are positive intersections of High Grade Ore up to (-) 128 mRL in North along 400m away from present working. Similarly the Deeper level exploration in southern extension has indicated presence of mineralization at the depth of (-) 125 mRL along 200 m away from the existing working.

3.5.3.4 Development and Stopping method

The upper, steep dipping section of the orebody is accessed via a central level access from each decline which connects to longitudinal (along strike) north and south ore drives. Stopes are mined in a retreat sequence back to the central access. The lower, flat lying section of the orebody is accessed via footwall drives developed north and south from the decline accesses, along the strike extent of the orebody. Transverse drives provide access to the stopes from the footwall drives.

Longitudinal Long hole open stoping (LHOS) method is proposed for the steeper portion up to 225 mRL and Long Hole Open Transverse stoping is proposed for the shallow (almost flat) portion of ore body below 225 mRL. In Block III wherever ore body is steeper Longitudinal Open Stopping Method is proposed. All the mining is planned with back filling with Rock fill (RF) and Cemented rock fill (CRF). Other Mining Methods such as Drift and fill method may be considered wherever ore body configuration requires.

The blasted muck from stope is then withdrawn at extraction level through LHDs and then directly loaded in to mine trucks for hauling through ramps from underground to surface stock yard. From stock yard, ore is dispatched to Rampura Agucha Mine for further Mineral processing.

3.5.3.5 Selection of Mining Equipment and Size:

Below Table shows, the existing and proposed machinery required for expansion project. However final selection of mining equipment and size may be subjected to some changes on account of variation in ore body, rock mechanics consideration affecting stope dimensions and approval of the statutory authorities.

TABLE: DETAILS OF MACHINERIES

S. No.	Particulars	Capacity
1	LPDT (63t/60t/ 50t/30t/ 20t)	63t/60t/50t/30t/20t payload
2	LHD (21t/ 17t/ 10t/ 7t)	21t/17t/10t/7t payload
3	Drill Jumbo	32-45mm ϕ holes
4	Electro Hydraulic Drill	64-102mm ϕ holes

5	ITH Production Drills	102-165mm ϕ holes
6	Main Ventilation fans	100-233cum/sec
7	Pumps	50-100cum/hr
8	Cage Winder	800kW (80 persons capacity)
9	Road Grader	Maintaining haul roads
10	Rock Bolter	32-38mm
11	Mobile Carrier Exploration Rig	38mm
12	Charmec	For mechanized charging
13	Scaler	For loose scaling
14	Personnel Carrier	16 & 32 persons
15	Lifting Equipment	3000 kg
16	Light Motor Vehicles	5 persons
17	Explosive Carriers	3.9t
18	Water Sprinkler	3.0 cum
19	Compressors	1000cfm-2500cfm

3.5.4 Mineral Beneficiation

The ore produced at the Kayad Mines is sent to Rampura Agucha Mines for beneficiation in the existing mills of 6.5 MTPA capacities which is sufficient to cater the proposed expansion additional capacity.

3.6 Water & Power Requirement & Sources

3.6.1 Water Availability

No additional water is required for proposed expansion over existing 560m³/day requirement. Mine dewatering will be reused for Drilling, dust suppression, CRF and recharge with in mine premises.

3.6.2 Power Availability

No additional power envisaged for the proposed expansion project. The power is supplied by AVVNL through grid and distributed to mine via surface sub-station (33KV) located within the mine boundary. Present power requirement is around 5.0 MW.

3.6.3 Emergency Power

In case of any power shortage or failure the captive stand by DG (1MVA) set is available to provide power. No additional emergency power is required for the proposed expansion project.

3.7 Qty of Waste to be generated (Solid & Liquid) Wastewater Generation and its Management

3.7.1 Solid Mine Waste

The waste rock generated during mining operations was earlier being stacked at waste dump at surface. The waste dump area is of 1.0 Ha and on the surface acquired area. With the subsequent increase in quantum of stoping, the waste rock was being directly taken into use as cemented rock fill in belowground. Additional waste generation due to development activities is envisaged to 8,55,000 tonnes. Thus as per proposed plan Waste generation during next 4 years will be 14,50,000 tonnes as compared to existing 5,95,000 tonnes.

In the proposed expansion of Kayad Mine, no additional waste will be dumped on the surface beyond the already approved waste quantity and hence no additional waste dump is envisaged. The increased waste generated will be disposed off into the underground voids. Additional waste required for backfilling will be utilized from Rampura Agucha Mine.

3.7.2 Tailing Disposal

As the ROM ore is being transported to Rampura Agucha Lead Zinc Mines for beneficiation, no tailing will be generated at site. The mine water will be re-used and there will not be any discharge from the mine, hence no adverse impact is anticipated on ground water quality.

3.7.3 Used oil and other waste

Used oil generated shall be stored at earmarked area in drums and shall be sold to registered/ authorized recyclers; No additional used oil and Oil contaminated waste generation is envisaged. No change in other waste for the proposed expansion.

4.0 SITE ANALYSIS

4.1 Connectivity

The Kayad village is 9 Km NNE of Ajmer city and is well connected by tar road. Jaipur, the state capital is 127 km NE of the deposit and nearest airport is Kishangarh at 20 Kms from site. Although the nearest railway station is Madar (B.G.) at 6 km to the south of Kayad, the main railway station is at Ajmer on Ajmer-Kishangarh section of North Western Railway, 9 km SSE of Kayad. NH 79 Jaipur-Ajmer is at about 3 Km from site.

4.2 Land Form, Land use and Land Ownership

4.2.1 Land Form

The area is undulating with altitude varying from 480 to 506 mRL. The highest point is a small hillock just east of the village Kayad, attaining an altitude of 506 mRL. The area is mostly soil covered with a few outcrops here and there. The seasonal "Kala Nala" (outside the ML) flowing from south to north joins Phool Sagar reservoir near Kayad village. The drainage is a seasonal and is mostly of dendritic pattern and there is no watercourse other than seasonal "Kala Nala" in the area.

4.2.2 Land Use& Ownership

Total Mine lease area is 480.45 ha, out of which 48.50 ha has been acquired within mining lease. There shall be no requirement to acquire land beyond the existing acquired land. The mine area in operational use will suffice the requirement. Breakup of land use of lease area is shown as under:

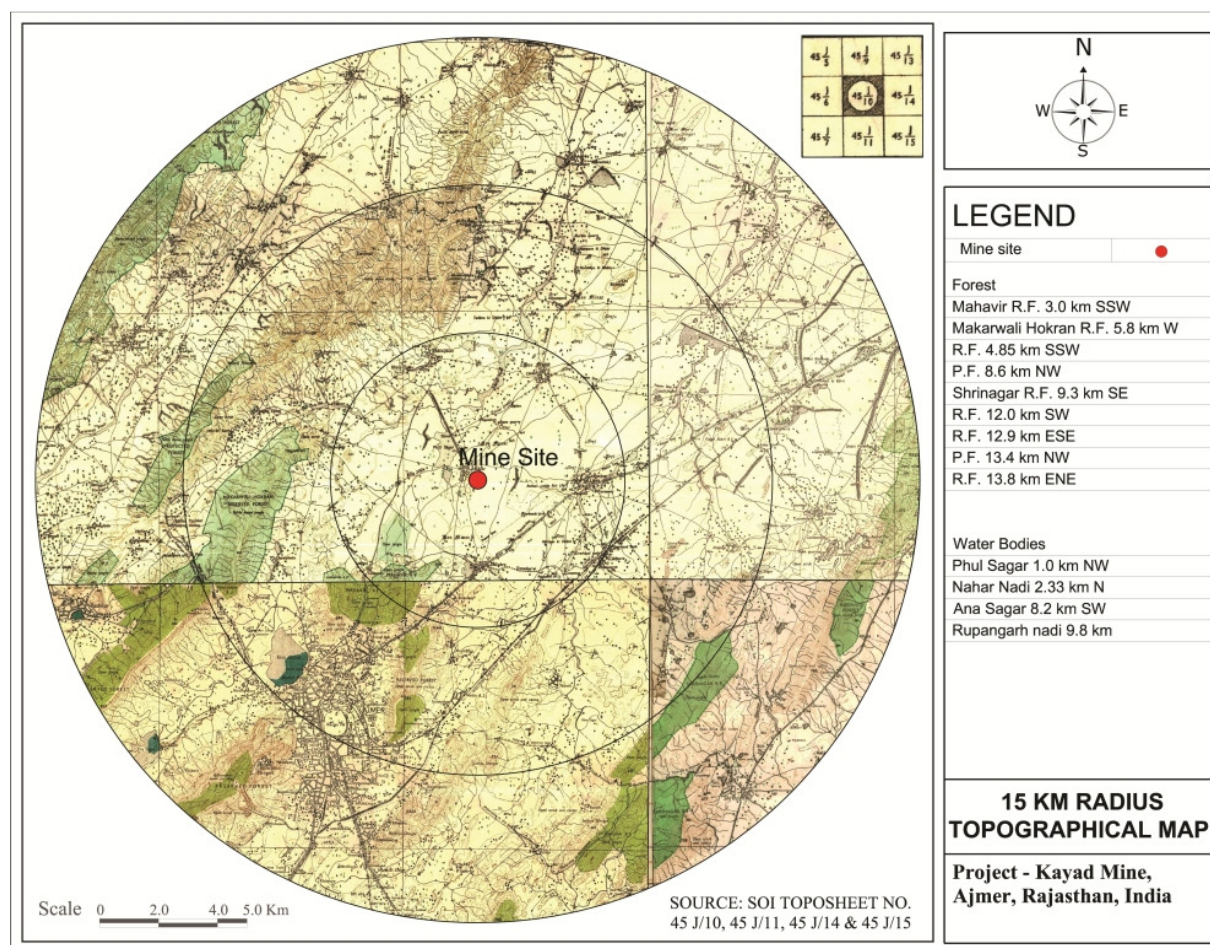
TABLE:LAND USE

Particulars	Present Land use (ha)	Proposed Land use (Ha)
a) Area to be excavated	0.73	0.73
b) Storage of top soil	0.24	0.24
c) Overburden / Dump	1.0	1.0
d) Mineral storage	1.4	1.4
e) Infrastructure (workshop, buildings, Parking etc.)	2.4	2.4
f) Road	0.88	0.88
g) Green Belt	21	26.0
h) Water storage tank	0.06	0.06
i) Surface water bodies/ponds	1.3	1.3
j) 1 MT Magazine	0.01	0.01
k) Bulk Emulsion plant	0.35	0.35
l) Open spaces	19.13	14.13
Total (A-L)	48.5	48.5
<i>Land use (Ownership & Occupancy Status)</i>		
i) Private Land		445.82
ii) Charagah		11.10
iii) Govt. Land		23.53
GRAND TOTAL/Lease Area		480.45

4.3 Topography

Topography of the area is shown in attached map

TOPOGRAPHICAL FEATURES OF THE AREA WITHIN 15.0 KM RADIUS



4.4 Existing Infrastructure and Amenities

Kayad Mine is well equipped with infrastructures like Administrative office, Work Shop, Vocational training Center, Rescue room, Canteen, Rest Room, Washrooms, Ambulance, First-aid facilities, Refuge Chamber etc.

4.6 Soil Classification

It has been observed that the pH of the soil in the study area ranged from 7.9-8.2. The electrical conductivity was observed to be in the range of 0.32-0.42 mmhos/cm. The nitrogen values range between 338.2 -386. Kg/ha. The phosphores value range between 44-56 kg/ha. The potassium values range between 122-146 kg/ha. NPK values were found to be medium to less in most of the locations.

4.7 Climatic Conditions

The climate is tropical to semi arid. The day temperature attains to 40° to 46°C in May-June but falls to 4 to 10°C in December-January. Rainfall is restricted to monsoon period between July and September and average annual rainfall between 2001 and 2016 was 312 mm.

The average data on climatic conditions are represented below:

Temperature: Max. 45.7°C, Min. 4.6°C
 District average rainfall: 50.73 cm (10 years)
 Wind direction (winter): South West and West
 Wind direction (post monsoon): South West followed by North East & North West
 Avg. wind speed: 1 to 20 kmph
 Avg. relative humidity: 46%

4.8 Social Infrastructure available

The existing social infrastructure available within 15 kms includes the following:

- Hospitals
- Bank
- Post Office
- School
- Police Station
- Shopping Market
- Sports Infrastructure
- Gym
- Club House

5.0 PLANNING

5.1 Planning Concept

The present proposal is for expansion of Lead – Zinc ore production from underground mine from 1.0 million TPA (ROM) to 1.2 million TPA (ROM) [20% increase].

From the ore reserves and mineral resources summary as on 01.10.2017 estimated reserves and resources of Kayad mine stands at 9.74 Mt (1.17% Pb, 7.23% Zn). For a 1.2 Mt per annum of production, the life of the mine as per existing reserve comes to approximately 6 years. Apart from this potential of 2.21 Mt of resources is established by exploration which is still continued. The additional resources are expected to further enhance the mine life.

Longitudinal Long hole open stoping (LHOS) method is proposed for the steeper portion up to 225 mRL and Long Hole Open Transverse stoping is proposed for the shallow (almost flat) portion of ore body below 225 mRL. In Block III wherever ore body is steeper Longitudinal Open Stoping Method is proposed. All the mining is planned with back filling with Rock fill (RF) and Cemented rock fill (CRF). Other Mining Methods such as Drift and fill method may be considered wherever orebody configuration requires.

5.2 Population Projection

As per 2011 census, 47,792 persons inhabited in 16 villages of the study area (within 10 km radius). The distribution of population in the study area is shown below:

TABLE: DISTRIBUTION OF POPULATION IN STUDY AREA

Particulars	Study Area
Male Population	24578
Female Population	23214
Total Population	47792
Population density	212.82
Female / Male ratio	0.9064
% literacy	62.68

Source: As per the 2011 census record.

The males and females constitute to about 51.4% and 48.6% of the study area. In this area, no major industries are expected. Therefore, normal growth of population is expected.

5.3 Assessment of Infrastructure Demand

The infrastructures have already been completed for the present operations. The same facility is adequate for the proposed project thus not making any perceptible impact on the landscape

5.4 Amenities and Facilities

- i) Drinking water supply
- ii) Medical Facilities
- iii) Animal Husbandry Camps
- iv) Support in agriculture
- v) Support to Anganbadi Centers
- vi) Enhancing computer literacy and providing computers.

6.0 PROPOSED INFRASTRUCTURE

6.1 Industrial Area

For the proposed project, no additional infrastructure development is required other than mining equipment.

6.2 Green Belt Development:

Thick vegetation is developed along the mine lease boundary to attenuate the noise levels generated in the mine lease area. The plantation will be carried out along the roads within the mine boundary to arrest dust. At present, 21 ha is developed with plantation and it will be raised up to 26 ha for next 5 years as per proposed plantation plan which is more than 33% of the acquired area.

6.4 Connectivity

The Kayad village is 9 Km NNE of Ajmer city and is well connected by tar road. Jaipur, the state capital and nearest airport is 127 km NE of the deposit. Although the nearest railway station is Madar (B.G.) at 6 km to the south of Kayad, the main railway station is at Ajmer on Ajmer-Kishangarh section of North Western Railway, 9 km SSE of Kayad. NH 8 Jaipur-Ajmer is at about half a km.

6.5 Drinking water management

Freshwater is being sourced from PHED for domestic Consumption. The drinking water facilities are being developed. Potable water is being/will be made available for all the employees.

6.6 Waste Water management

Mine water generated in the mining activity is suitably treated and reused in wet drilling operations, dust suppression, Cemented rock fill, in underground operation and in sprinkling on surface roads for dust suppression and Plantation. Zero discharge is being/will be maintained from mining premises.

6.7 Solid Waste Management

Solid waste occurs in two forms from mine described as under:

- **Mine Rock Waste**

The waste rock generated during mining operations was earlier being stacked at waste dump at surface. The waste dump area is of 1.0 Ha and on the surface acquired area.

With the subsequent increase in quantum of stoping, the waste rock was being directly taken into use for cemented rock fill in belowground. Additional waste generation due to development activities is envisaged to 8,95,000 tonne. Thus as per proposed plan Waste generation during next 4 years will be 14,50,000 tonne.

In the proposed expansion of Kayad Mine, no additional waste will be dumped on the surface beyond the already approved waste quantity and hence no additional waste dump is envisaged. The increased waste generated will be disposed off into the underground voids. Additional waste required for backfilling will be utilized from Rampura Agucha Mine.

- **Mill Tailings**

As the ROM ore is being transported to RA Mine for beneficiation, no tailing will be generated at site.

6.8 Power requirement & supply/ source

No additional power is required for the proposed expansion.

7.0 REHABILITATION AND RESETTLEMENT (R&R) PLAN

No additional land needs to be acquired therefore, no R&R is applicable.

8.0 PROJECT SCHEDULE AND COST ESTIMATES

8.1 Project Schedule: The project will be executed within current financial year after grant of EC & Consents.

Yearly Production schedule (Mt):

<i>Lens</i>		<i>Level</i>	<i>Northing</i>	<i>2017-18</i>	<i>2018-19</i>	<i>2019-20</i>	<i>2020-21</i>	<i>Total</i>
S1 Lens		300mRL to 450mRL	N9640 to N9815	0	0	25000	135000	160000
Block I	K1 Lens	375mRL to 450mRL	N10490 To N10710	0	0	50000	80000	130000
	375 & above	375mRL to 425mRL	N9960 To N10740	0	50000	50000	17000	117000
Block II	Pillar	300mRL to 325mRL	N9960 To N10740	90000	0	0	0	90000
	Main Lens	225mRL to 300mRL	N9930 To N10800	14000	0	0	0	14000
Block III	Main Lens	150mRL To 225mRL	N10000 To N10780	941000	1038000	955000	780000	3714000
	Main Lens	50mRL to 150mRL	N10000 to N10255	0	57000	85000	173000	315000
				1045000	1145000	1165000	1185000	4540000
				155000	55000	35000	15000	260000
				1200000	1200000	1200000	1200000	4800000

8.2 Capital Cost Estimates

The capital cost for the proposed expansion project has been estimated at Rs. 171.cr.

9.0 ANALYSIS OF PROPOSAL

9.1 Financial Benefit

The proposed project shall generate foreign exchange to the country by exporting Zinc; additionally, it will also reduce import of phosphoric acid thus saving of foreign exchange. This will also generate revenue to the state Government as well as central government. The people around the region will get direct and indirect employment thus improves the financial status.

9.2 Employment generation due to project

The existing operation has direct employment of about 629 persons and the proposed project will be managed by the existing resources but there is an ample opportunity for increase in indirect employment due to mining related activities like transport, small workshops, garages, and due to development of local area.

9.3 Social Economic Development

The proposed expansion project will bring in people from different cultures for secondary employment like transporters, vendors, local canteen and tea stall operators etc. such as:

- Generate indirect employment opportunities;
- Real estate development;
- Increase in purchasing power;
- Development of ancillary small scale supporting electro mechanical services for automobile's, civil, electrical and mechanicals etc. as part of CSR.
- Agriculture marketing and increased demand for locally produced farm products for large number of employees existing in the project;
- Access to high quality health care facilities;
- Women empowerment;

9.4 National Economic Development

The present production capacities of Zinc in India are sufficient to meet the domestic requirements. However, the demand for zinc in India is expected to grow at a rate of 7.1% which makes it viable for the expansion of the zinc production capacities. Further the deficit in international market during the upcoming years provides opportunity for export.

9.5 Export Possibility

Indian exports majorly catered to South East Asian and African nations. In India, since, Hindustan Zinc is the largest producer of primary zinc, export of zinc is highly feasible and shall bring value addition.

9.6 Land value appreciation

The infrastructure development related to the proposed project is likely to cause appreciation of real estate prices in the nearby areas. Locals with land holdings in neighbouring areas are likely to benefit economically.

9.7 Social Benefits

The proposed project shall proactively participate in the upliftment of socio economic index of the communities around the project site by way of financial and administrative support. The project will open up employment opportunities, directly and also indirectly. There shall be opportunities for entrepreneurs to engage in many service sectors directly or indirectly associated with the project.

The CSR approach of the company shall be towards sustainable livelihood management of the community around. There shall be focus on education, health, sanitation, drinking water, agriculture, water shed management, culture identity preservation, welfare of socially weaker sections and marginalized people.
