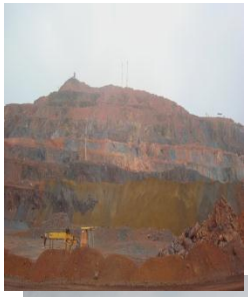
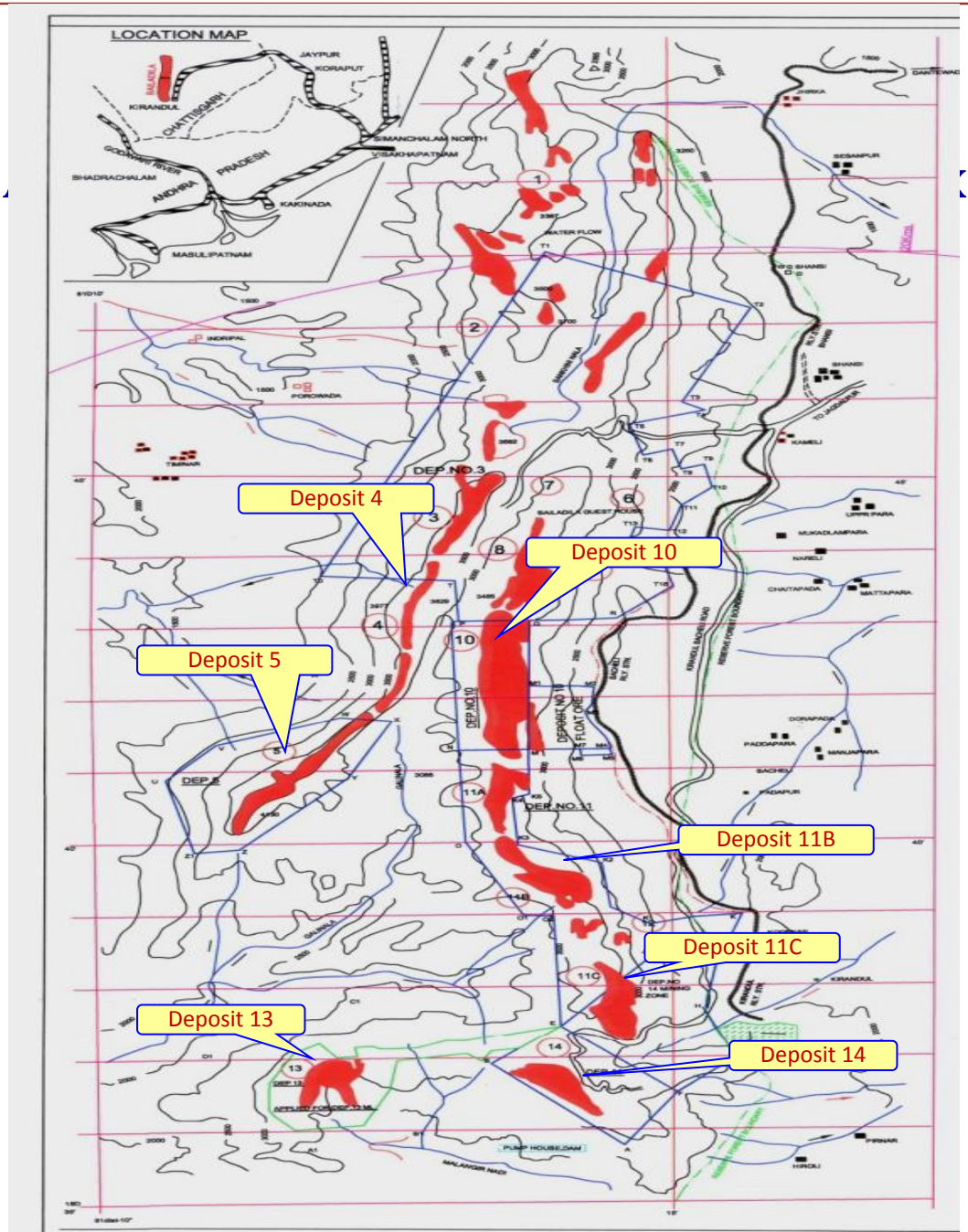
NMDC LIMITED



Threshold value of Iron Ore

By: Dr A S Singh, Sr. Manager(Geology)

PLAN SHOWING IRON ORE DEPOSITS IN BAILADILA COMPLEX



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BACKGROUND

- **"Threshold Value of Minerals" means limit prescribed by the Indian Bureau of Mines from time to time based on the beneficiability and or marketability of a mineral for a given region and a given time**
- **As per Gazette notification 16th Oct'2009-**

- **IRON ORE:**

- **1. Hematitic iron ore : 45% Fe(Min)**
- **2. Haematitic Siliceous Ore (For Ore of Goan Origin): 35% Fe (Min)**

Overview of Bailadila Iron Ore Mines

" **Bailadila**" range of hills derives its name from the shape of the hills ,which look like 'the hump of an ox'.

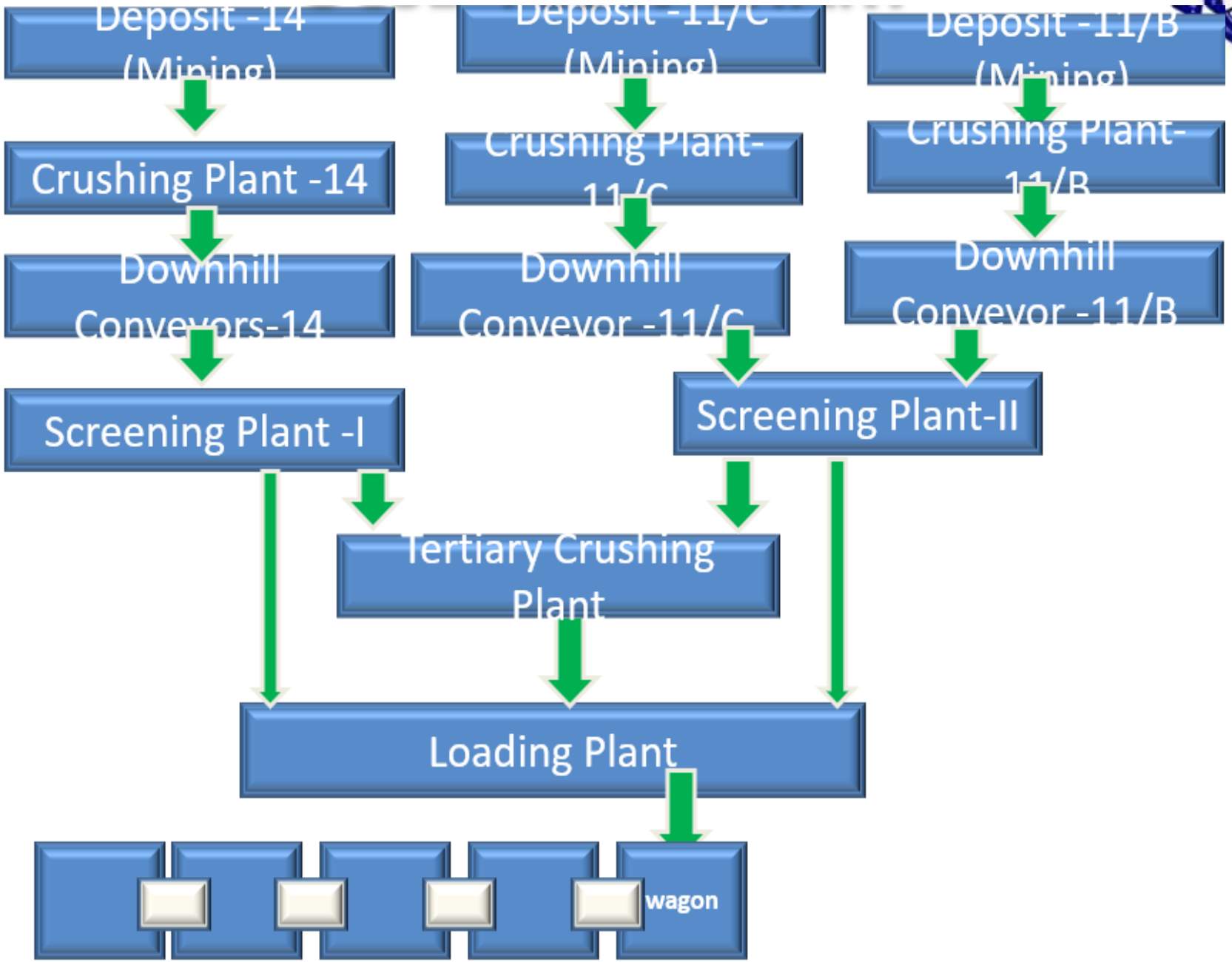
The range comprises of 14 Deposits, Deposit No.1 to 5 in Western ridge, Deposit No. 6 to 12 in the Eastern ridge and Deposit 13 & 14 being the southern closure of Bailadila Range.

	Dep.14	Dep.11C	Dep.11B
MINING OPERATIONS COMMENCEMENT YEAR	1968	1987	2015
PRODUCTION SINCE INCEPTION	161 MT	124 MT	14 LT

Types of the Ore

BENCH	SGH		BGH		LAMINATED		LATERITE		BLUE DUST		5 Si		YELLOW OCHRE		FLOATORE		SUBGRADE		TOTAL		WASTE	REC%	STP RATIO
	QTY(LT)	Fe%	QTY(LT)	Fe%	QTY(LT)	Fe%	QTY(LT)	Fe%	QTY(LT)	Fe%	QTY(LT)	Fe%	QTY(LT)	Fe%	QTY(LT)	Fe%	QTY(LT)	Fe%	QTY(LT)	Fe%			
Dep14	941.49	67.88	480.91	65.81	476.11	63.09	280.17	57.65	1141.30	65.72	111.64	56.76			50.71	52.00	173.85	51.27	3656.18	64.18	1020.35	49.90	0.28
Dep.11C	90.47	67.99	967.19	66.58	268.08	63.41	197.08	60.86	535.06	67.40			56.86	57.61			54.51	50.95	2169.25	65.30	1009.54	52.26	0.47
Dep.11B	507.89	68.42	668.00	66.92	148.34	64.43	21.80	58.81	524.95	67.05	24.25	59.73			41.77	57.82	18.42	51.64	1955.42	66.64	276.36	56.50	0.14
Total	1539.85	68.07	2116.11	66.51	892.53	63.41	499.06	58.97	2201.30	66.45	135.88	57.29	56.86	57.61	92.48	54.63	246.78	51.23	7780.85	65.11	2306.25	51.73	
INCIDENCE %	19.79		27.20		11.47		6.41		28.29		1.75		0.73		1.19		3.17		100.00				

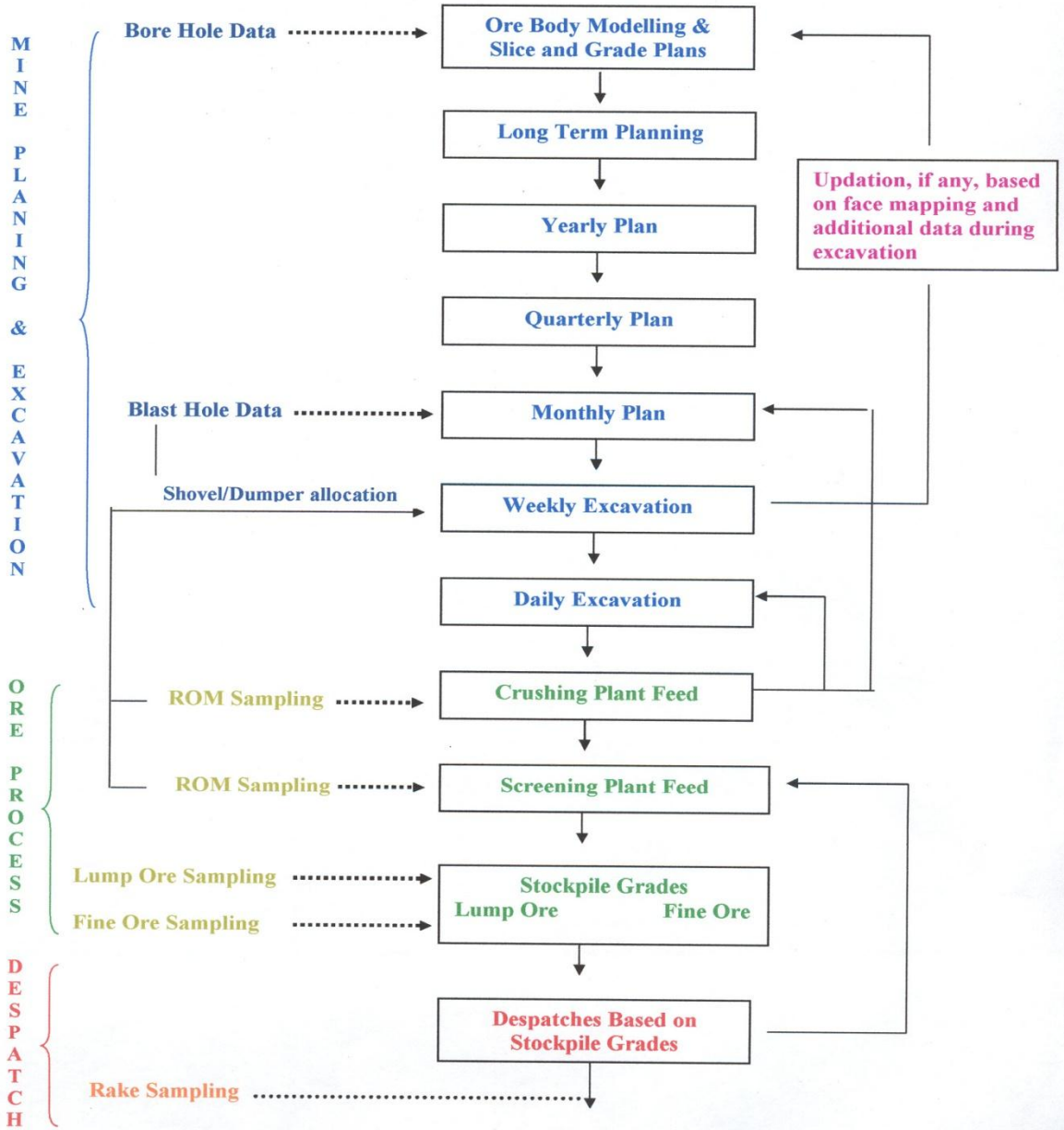
OCSL FLOW CHART



Steps/stages in Quality control

- Mine Planning and Excavation stage
- Ore Processing stage
- Stockpiling
- Loading stage
- Weekly Quality Review Meetings
- Corrective/Preventive Steps
- Updation of plans regularly

Flow Chart of Quality Control



PRESENT WORKING AT MINING & PROCESSING

- **ADOPTED ZERO DISCHARGE FROM MINE AND BENEFICIATION PLANT HEAD.**
- **NO WET SCREENING.**
- **MAINTAIN ENVIRONMENTAL CONCERN.**

PRESENT PRACTICAL CONSTRAINTS IN MINING & PROCESSING

- **THRESHOLD VALUE OF IRON ORE HAS BEEN REDUCED BY IBM FROM 55% Fe TO 45% Fe.**

- **ULTIMATE PIT LIMIT EXTENDED SUBSTANTIALLY AFTER DEEP HOLE DRILLINGS.**

- **REQUIRES MORE SPACE FOR HANDLING WASTE AND SUBGRADE.**

PRESENT PRACTICAL CONSTRAINTS IN MINING & PROCESSING

THE REMOTE LOCATION : MINE FOLLOW ZERO DISCHARGE POLICY AND THE FREIGHT CHARGES ON THE MINERAL IS VERY HIGH DUE TO REMOTE LOCATION.

SUB GRADE STATUS AT MINE

	Dep.14(T)	Dep.14NMZ(T)	Dep.11B(T)
Subgrade Blended(2016-17)	165000	140000	50000
Subgrade available	324000	265000	72000

WASTE STATUS AT MINE

	Dep.14(MT)	Dep.14NMZ(MT)	Dep.11B(MT)
Waste in dumps	12	6	3.2

Specifications of Bailadila ore

PARAMETERS	BAILA LUMP	BAILA ROM	SIIL CLO	DR CLO
Fe% (base)	65.5	65.5	65.5	67.0

Baila fines

	EXPORT	VSP	ESSAR (FO + S)
Fe% (base)	65.0	64.0	64.0
Size		(-) 10mm	

INDUSTRY REQUIREMENT

- **Quality of ore results in optimizing costs, improvement in productivity etc.**
- **In iron ore, key chemical parameters are Fe, SiO_2, Al_2O_3 & P apart from LOI, moisture, trace elements**
- **Ideal physical properties allow all zones to perform satisfactorily their respective functions as distributors of gas, heat etc in the furnace**
- **Consistency in quality is a key factor compared resource position**

INDUSTRY REQUIREMENT

- Chemical Properties (High Iron content & Low Gangue)
- Physical Properties (Close size Range, High TI & Low AI)
- Metallurgical Properties (Good reducibility and Metallization, Low RDI etc.)

INDUSTRY REQUIREMENT

- For any industry the requirement of raw material is strictly based on the Process Design and End Product
- Therefore, quality norms/requirements of raw materials are not uniform and demand is for consistent ore quality
- Tolerance of deviation in quality should be within the accepted norms of standard deviation

INDUSTRY REQUIREMENT

Radical	Blast Furnace	Steel Making	Sintering	Pelletisation
Fe % (min)	64	62-68	63-64	63-64
SiO_2% (max)	2-2.5	2-3	2.5-3	2.5-3
Al_2O_3% (max)	2-2.5	2-3	2.5-3	2.5-3
Al_2O_3: SiO_2 (max)	1.6			
S% (MAX)	0.03			
P% (max)	0.03	0.03-0.1		0.08
SIZE	10-40mm (lumps) sinters, pellets (15mm)	50-150	-10+0.15	-325# (85% min)

CUSTOMER COMPLAINS

Silica

Alumina

Silica +Alumina is demand to maintain below 5%, which are very hardly being maintain as per requirement of customer specification.

LOI **At present level of threshold value the LOI comes between 3-3.5 %. The customer requirement is below 3% which is creating some problem with customers.**

NMDC: VISION PLAN – 100 MT

PRODUCTION CAPACITY ENHANCEMENT PLAN –

30 MTPA FROM KIRANDUL COMPLEX.

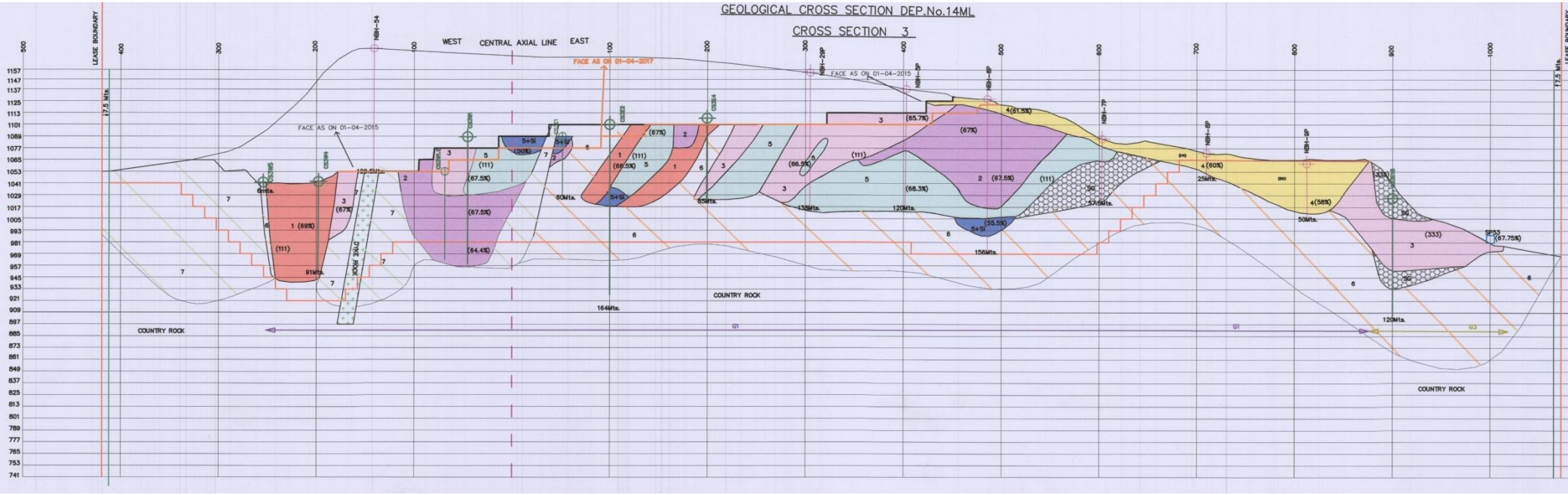
ACHIEVING 10 MT PRODUCTION FROM EACH DEPOSIT BY THE YEAR 2024-25.

TARGETED PER DAY PRODUCTION FROM THREE MINES ~ 98000 TONNES.

DEP.14

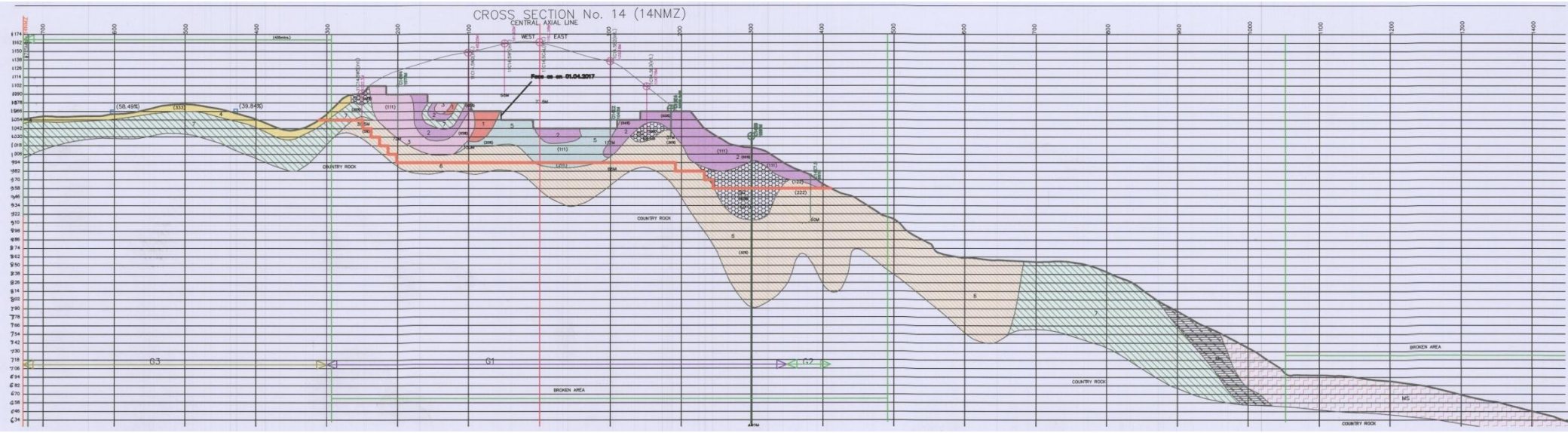
View of Dep. 14 Mine

Typical cross section of Dep14 Bailadila Iron Ore Mines



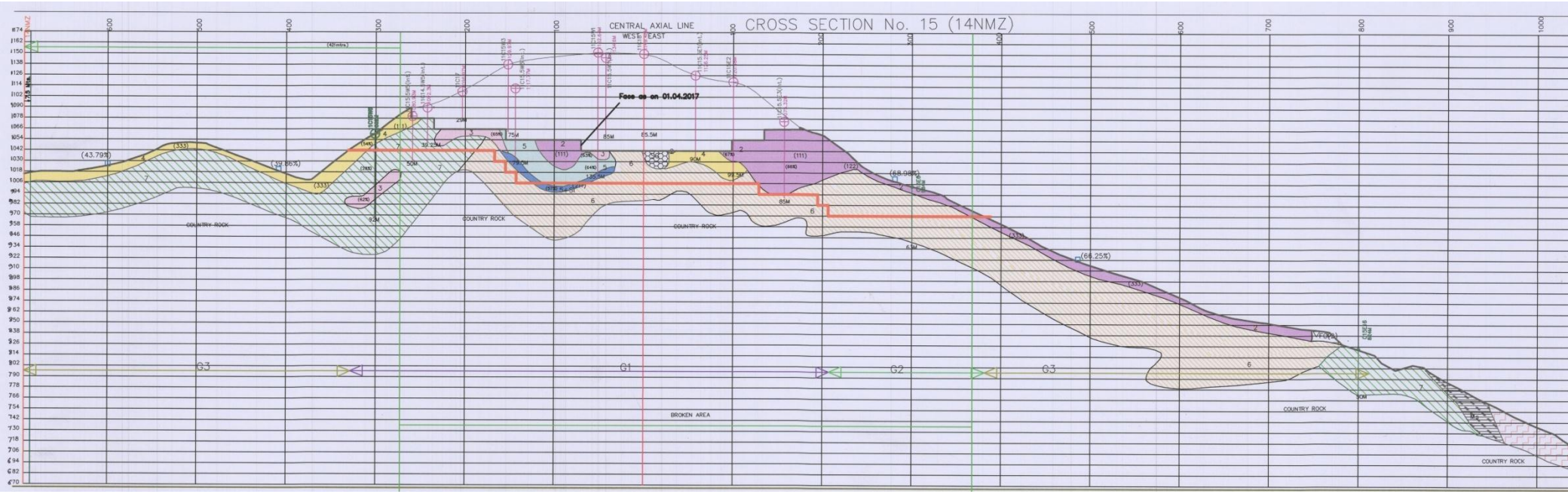
DEP.11C

Typical cross section of Dep14NMZ Bailadila Iron Ore Mines

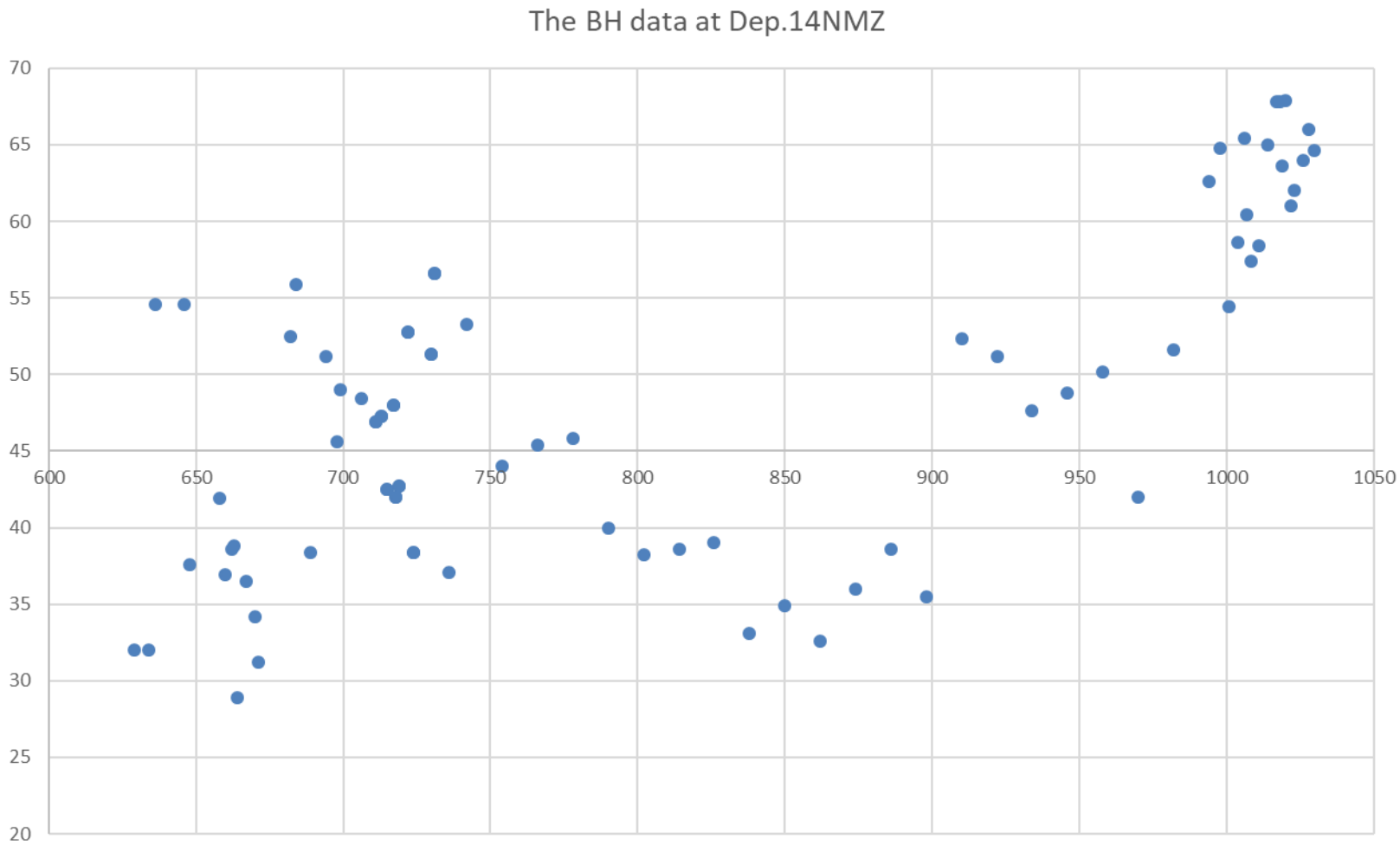


DEP.11B

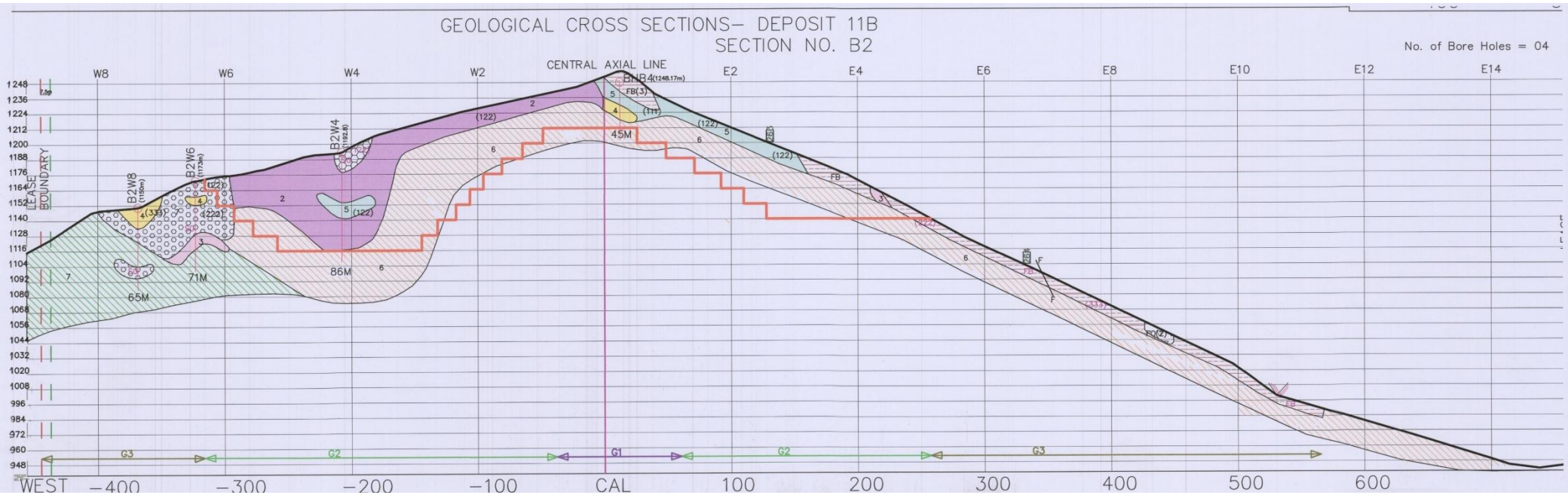
Typical cross section of Dep14NMZ Bailadila Iron Ore Mines



Typical BH 402 m of Dep14NMZ Bailadila Iron Ore Mines



Typical cross section of Dep11B Bailadila Iron Ore Mines



The Natural Cut-off in iron ore

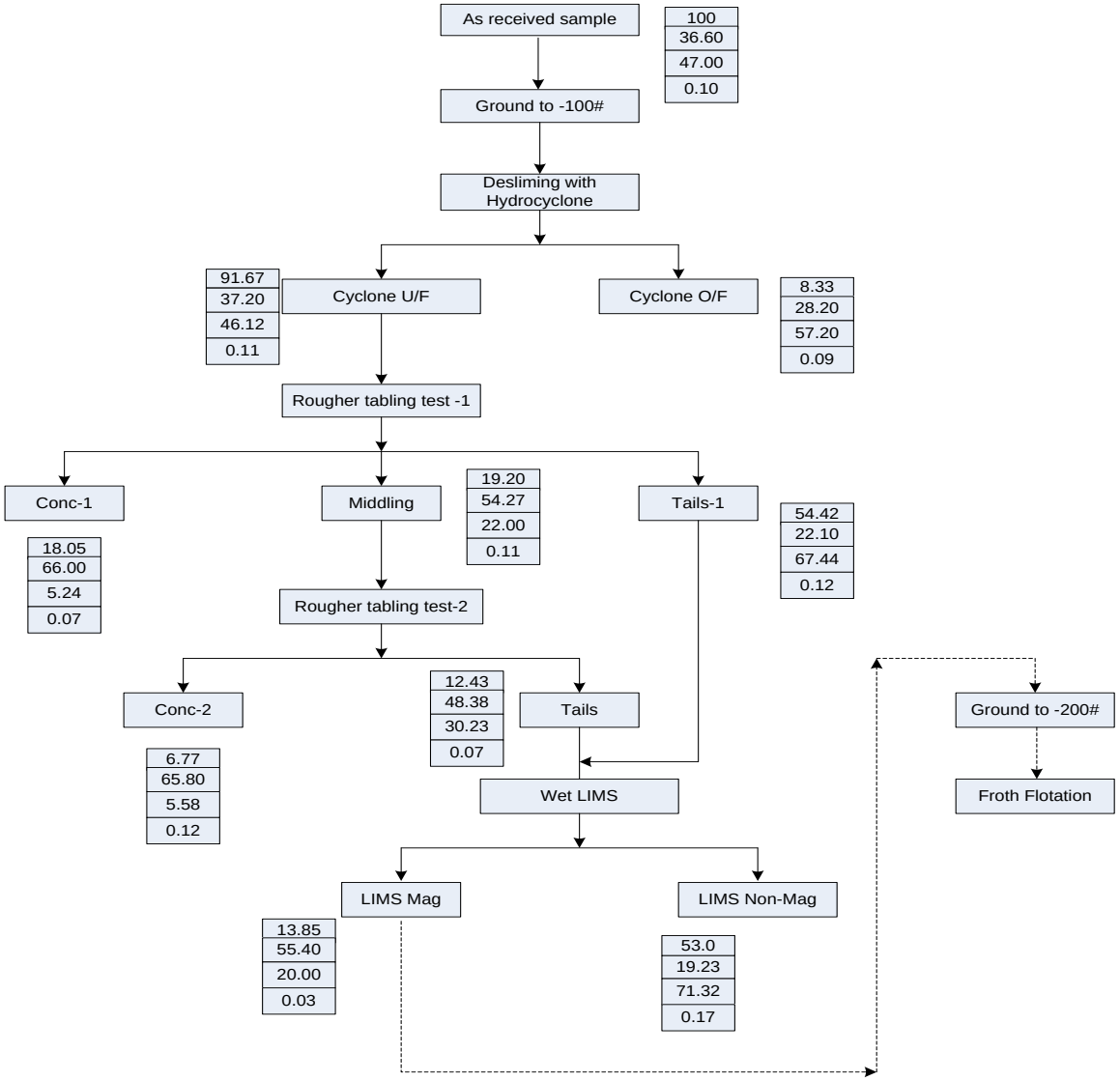
1. 58% Fe (include SGH, BGH, BD, Laterite, Limonite, Ocherous)
2. 55% Fe (Includes low grade Laterite, Ocherous, flaky ore)
3. 45% Fe (include Siliceous Blue dust, enriched BHQ)
4. 32% Fe (include BHQ and ferrugenous shale
5. 25% Fe (include ferruginous shale)

The Natural Cutoff in iron ore

1. Iron Ore (SGH, BGH, BD, Laterite, Limonite, Ocherous low grade Laterite, Ocherous, flakey ore Siliceous Blue dust, enriched BHQ), Fe is free at 100#
2. 45% Fe
3. BHQ , Fe is at interlocking with host rock
4. Shale

BHQ Characterization

Test Scheme -1 of Beneficiation studies of BHQ



EFFECT ON CHANGE IN CUT- OFF

1. Ore Type incidence
2. Reserve
3. Average grade of the total ore
4. Mining
5. Beneficiation
6. Steel industry
7. Quality of end product

APPROACH

NMDC approach is towards maximum utilization of natural resources and to achieve this we have set a research and development wing at R&D Hyderabad. The further research for utilization of low grade ore / waste is being under development.

CONSLUSION

1) BHQ contain Hematite with varying composition of martite and Quartz as major gangue mineral
2) The Fe contains of hematite is at interlocking with gangue minerals.
3) The concentrate **of 65.90% Fe with 24.82% yield** could be achieved in laboratory by the process of Wilfley table, LIMS and Froth Flotation which is not economically viable.
4) The studies shows that the characterization of BHQ (mother rock of iron ore) is not similar to the other iron ore.

CONSLUSION

5) The inclusion of BHQ in ore by blending will lead the tail generation and spoil the quality of Iron ore without gaining much Fe for utilization in steel industry.
6) The extraction of Fe from BHQ requires separate process of handling and beneficiation process.
7) Thus the present threshold value (45% Fe) in the Iron ore Mining at Bailadila Sector is at its natural position.
8) Further lowering the threshold value will lead the tail generation with more than 80% of its iron value.
9) Lowering threshold value from 45% Fe will result lowering of Average iron grade of production material and enhance the other accessories, SiO_2, Al_2O_3 and LOI which will invite marketability issues and grade problems for customers also.
10) NMDC opines that 45% threshold value of Fe for hematite ore is optimum.


THANK YOU