

VOLUME-I

**SARHAD DEVELOPMENT AUTHORITY
GOVERNMENT OF N.W.F.P.
PESHAWAR**



*Industrial Rocks Mineral
Acc. No. -
C.I. -*

**FINAL GEOLOGICAL REPORT
OF THE SCHEME**

**"SURVEY AND EXPLORATION OF LIMESTONE AND CLAY DEPOSITS
FOR BASING CEMENT PLANTS IN N.W.F.P. TO FACILITATE
JOINT VENTURES IN
MINERAL AND INDUSTRIAL SECTORS"**

[Signature]
26/8/2000

June, 1997

VOLUME-I

**SARHAD DEVELOPMENT AUTHORITY
GOVERNMENT OF N.W.F.P.
PESHAWAR**

*Now Directorate General Mines & Minerals, NWFP
Exploration Promotion Division.*



**FINAL GEOLOGICAL REPORT
OF THE SCHEME**

**"SURVEY AND EXPLORATION OF LIMESTONE AND CLAY DEPOSITS
FOR BASING CEMENT PLANTS IN N.W.F.P. TO FACILITATE
JOINT VENTURES IN
MINERAL AND INDUSTRIAL SECTORS"**

*Limestone & Clay Deposits in NWFP for
Basing Cement Industry.*

June, 1997

Scanned By Mujeeb Alam (D.E.O)

S.NO.	DESCRIPTIONS	PAGE
2.11	AUGER AND CORE DRILLING IN CLAY DEPOSITS AT SHAMOZAI-BABUZAI AREA-KATLANG	49-50
2.12	RAW MIX DESIGN AND BURNABILITY TEST STUDIES OF LIMESTONE AND CLAY DEPOSITS AT SHAMOZAI-BABUZAI AREA - KATLANG	51
2.13	INFRASTRUCTURE	52
2.14	CONCLUSION AND RECOMMENDATIONS	53-55
3.	<u>BANDA CHASHMA, KIRRI KHISOR AND KOTLA LODIAN AREA DISTRICT D.I.KHAN N.W.F.P.</u>	56
3.1	LOCATION AND ACCESSIBILITY	56
3.2	TOPOGRAPHY AND CLIMATE	57
3.3	GENERAL GEOLOGY	58-59
3.4	LOCAL GEOLOGY	60
3.5	STRUCTURAL GEOLOGY	61
3.6	SAMPLING AND CHEMICAL ANALYSIS	62-64
3.7	PETROGRAPHY	65-66
3.8	RESERVES OF LIMESTONE DEPOSITS AT BANDA CHASHMA AND KOTLA LODIAN AREAS D.I.KHAN	67
3.9	CLAY DEPOSITS	68
3.10	INFRA STRUCTURE	69
3.11	CONCLUSION AND RECOMMENDATIONS	70
4.	<u>PALAI AREA, MALAKAND</u>	71
4.1	LOCATION AND ACCESSIBILITY	71
4.2	TOPOGRAPHY AND CLIMATE	72
4.3	GENERAL GEOLOGY/LITHOLOGICAL UNITS	73-76
4.4	STRUCTURAL GEOLOGY	77
4.5	LOCAL GEOLOGY	78
4.6	SAMPLING AND CHEMICAL ANALYSIS	79
4.7	PETROGRAPHY	80-81
4.8	CLAY DEPOSITS	82
4.9	INFERRED RESERVES OF LIMESTONE DEPOSITS IN PALAI AREA MALAKAND	83-84
4.10	INFRASTRUCTURE	85
4.11	CONCLUSION AND RECOMMENDATIONS	86
5.	<u>TANGI AND SURROUNDING AREAS DISTRICT CHARSADDA</u>	87
5.1	LOCATION AND ACCESSIBILITY	87
5.2	GENERAL GEOLOGICAL SETTING/LITHOLOGICAL UNITS.	88-91
5.3	STRUCTURAL GEOLOGY	92
5.4	LOCAL GEOLOGY	93
5.5	SAMPLING AND CHEMICAL ANALYSIS	94
5.6	PETROGRAPHY	95
5.7	INFERRED RESERVES	96-97
5.8	CLAY DEPOSITS	98
5.9	INFRASTRUCTURE	99
5.10	CONCLUSION AND RECOMMENDATIONS	100

CONTENTS

S.NO.	DESCRIPTIONS	PAGE
	EXECUTIVE SUMMARY	1-2
	INTRODUCTION	3-4
1	<u>DARU KHULA AREA - NIZAMPUR</u>	5
1.1	LOCATION AND ACCESSIBILITY	5
1.2	GENERAL GEOLOGY	6-7
1.3	CONTOUR SURVEY	8
1.4	SAMPLING AND CHEMICAL ANALYSIS	9-11
1.5	PETROGRAPHY	12-14
1.6	CORE DRILLING IN LIMESTONE DEPOSITS AT DARU KHULA AREA, NIZAMPUR.	15-19
1.7	LOGGING OF CORE DRILLING IN LIME STONE DEPOSITS AT DARU KHULA AREA NIZAMPUR	20
1.8	RESERVES OF THE LIMESTONE DEPOSITS AT DARU KHULA AREA NIZAMPUR	21
1.9	CLAY DEPOSITS AT DARU KHULA AREA NIZAMPUR	22
1.10	AUGER AND CORE DRILLING IN CLAY DEPOSITS AT DARU KHULA AREA-NIZAMPUR	23-24
1.11	RESERVES OF THE CLAY DEPOSITS AT DARU KHULA AREA NIZAMPUR.	25
1.12	RAW MIX DESIGN AND BURNABILITY TEST STUDIES OF LIMESTONE AND CLAY DEPOSITS AT DARU KHULA AREA NIZAMPUR	26
1.13	INFRASTRUCTURES	27
1.14	CONCLUSION AND RECOMMENDATIONS	28-29
2.	<u>LIMESTONE AND CLAY DEPOSITS AT SHAMOZAI- BABUZAI AREA KATLANG DISTRICT - MARDAN.</u>	30
2.1	LOCATION AND ACCESSIBILITY	30
2.2	TOPOGRAPHY AND CLIMATE	31
2.3	GENERAL GEOLOGY	32
2.4	CONTOUR SURVEY	33
2.5	SAMPLING AND CHEMICAL ANALYSIS	34-35
2.6	PETROGRAPHY	36-39
2.7	CORE DRILLING IN LIMESTONE DEPOSITS AT SHAMOZAI AND BABUZAI AREA KATLANG.	40-44
2.8	LOGGING OF CORE DRILLING IN LIMESTONE DEPOSITS AT SHAMOZAI-BABUZAI AREA KATLANG	45
2.9	RESERVES OF LIMESTONE DEPOSITS AT SHAMOZAI BABUZAI AREA KATLANG	46
2.10	CLAY DEPOSITS AT SHAMOZAI-BABUZAI AREA KATLANG	47-48

S.NO.	DESCRIPTIONS	PAGE
6.	● <u>LACHI AREA DISTRICT KOHAT</u>	101
6.1	INTRODUCTION	101
6.2	LOCATION AND ACCESSIBILITY	102
6.3	TOTPGRAPHY AND CLIMATE	103
6.4	GENERAL GEOLOGY	104
6.5	STRUCTURAL GEOLOGY	105-106
6.6	SAMPLING AND CHEMICAL ANALYSIS	107
6.7	INFERRED RESERVES OF LIMESTONE DEPOSITS AT LACHI AREA KOHAT.	108
6.8	CLAY DEPOSITS OF LACHI AREA KOHAT	109
6.9	INFRASTRUCTURE	110
6.10	CONCLUSION AND RECOMMENDATIONS	111
7.	● <u>GADWALLIAN AREA DISTRICT HARIPUR</u>	112
7.1	INTRODUCTION	112
7.2	GENERAL GEOLOGICAL SETTING	113
7.3	STRUCTURAL GEOLOGY	114
7.4	SAMPLING AND CHEMICAL ANALYSIS	115
7.5	PETROGRAPHY	116-117
7.6	INFERRED RESERVES	118
7.7	CONCLUSION AND RECOMMENDATIONS	119
8.	MARKET REPORT ON CEMENT	120-127

LIST OF FIGURES

- I. FIG NO. 1.2 General Geological and Drill Hole points locations Map of Limestone and Clay Deposits at Daru Khula area Nizampur, District Nowshera.(Scale 1:50,000)
- II. FIG No. 1.3 General Geological and Drill Hole points locations Map of Limestone and Clay Deposits at Daru Khula area Nizampur, District Nowshera.(Scale 1:10,000)
- III FIG.No. 1.4 Samples location Map of Limestone and Clay deposits at Daru Khula area-Nizampur.(Scale 1:10,000)
- IV. FIG.NO. 1.5 Contour Survey Map along with profile and X-section of Limestone Deposits at Daru Khula area Nizampur(Scale 1:10,000)
- V. FIG NO.2.2 General Geological and Drill Hole points locations Map of Limestone and Clay deposits at Shamozaï-Babuzai area Katlang District Mardan.(Scale 1:50,000)
- VI. FIG NO.2.3 General Geological and Drill Hole points locations Map of Limestone and Clay deposits at Shamozaï-Babuzai area Katlang District Mardan.(Scale 1:10,000)
- VII FIG NO.2.4 General Geological and Samples locations Map of Limestone and Clay deposits at Shamozaï-Babuzai area Katlang District Mardan.(Scale 1:10,000)
- VIII FIG NO.2.5 Contour Survey Map along with profile and X-section of Limestone Deposits at Shamozaï-Babuzai area Katlang District Mardan.(Scale 1:10,000)
- IX. FIG No.3.1 b General Geological and samples locations map of Limestone deposits at Kirri Khisor Banda Chashma area D.I.Khan. (Scale 1:50,000)

LIST OF FIGURES

- | | | |
|------|--------------|---|
| I. | FIG NO.1.1 | Location Map of Limestone and Clay eposits at Daru Khula area- Nizampur, District Nowshera.(Scale 1:50,000) |
| II. | FIG NO.2.1 | Location Map of Limestone and Clay Deposits at Shamozaï - Babuzai area- Katlang District Mardan(Scale 1:50,000) |
| III. | FIG No.3.1 a | Location Map of Limestone at Kirri Khisor Banda Chashma area D.I.Khan. (Scale 1:50,000) |
| IV. | FIG No.3.2 a | Location Map of Limestone deposits at Kotla Lodian area D.I.Khan.(Scale 1:50,000) |
| V. | FIG No.3.3 a | Location Map of Clay Deposits at Band Korai area D.I.Khan. (Scale 1:50,000) |
| VI. | FIG No.4.1 | Location Map of Limestone and Clay Deposits at Palai area-Malakand.(Scale 1:50,000). |
| VII. | FIG No.5.1 | Location map of Limestone and Clay Deposits at Tangi and surrounding areas District Charsadda.(Scale 1:50,000) |
| VIII | FIG No.6.1 | Location map of Limestone and Clay Deposits at Lachi area District Kohat. (Scale 1:50,000) |
| IX. | FIG No.7.1 | Location map of Limestone and Clay Deposits at Gadwallian area District Haripur.(Scale 1:50,000) |

- X. FIG No. 3.2 b General Geological and samples locations: map of Limestone deposits at Kotla Lodian area D.I.Khan. (Scale 1:50,000)
- XI. FIG No. 3.3 b General Geological and samples location Map of Clay Deposits at Band Korai area D.I.Khan. (Scale 1:50,000)
- XII FIG No. 4.2 a General Geological and samples locations: Map of Limestone and Clay Deposits of Palai area Malakand. (Scale 1:50,000)
- XIII FIG No. 4.3 b General Geological and samples locations: Map of Limestone and Clay Deposits at Palai area Malakand. (Scale 1:10,000)
- XIV FIG No. 5.2 General Geological and samples location Map of Limestone and Clay deposits at Tangi and surrounding areas District Charsadda. (Scale 1:50,000)
- XV. FIG No. 6.2 General Geological and samples location Map of Limestone and Clay deposits at Jachi area Kohat. (Scale 1:50,000)
- XVI FIG No. 7.2 General Geological and samples location Map of Limestone and Clay deposits at Gadwallian area District Haripur. (Scale 1:50,000)

**LIST OF CONTRIBUTORS OF THE PROJECT SURVEY AND
EXPLORATION OF LIMESTONE AND CLAY DEPOSITS FOR
BASING CEMENT PLANTS IN NWFP TO FACILITATE
JOINT VENTURES IN MINERAL AND INDUSTRIAL SECTORS.**

<u>S.NO.</u>	<u>NAME AND DESIGNATION</u>	<u>CONTRIBUTION</u>
1.	Mr. Noroz Khan, Project Manager/Senior Geologist.	Overall Administrative Technical control and Preparation of Report.
2.	Mr. Matiullah Babar, Assistant Geologist.	i. Supervision of field exploratory activities. ii. Assistance in Data Compilation and Preparation of Geological Maps.
3.	Mr. Waleed Ahmad, G.M. (Minerals)	Supervision, Suggestions directives, information and technical discussion for preparation of the Report.
4.	Mr. Abdul Haleem, Project Accountant.	Assistance in Provincial Matters.
5.	Mr. Abdul Ghani, Tracer.	Tracing and drafting all the relevant Maps for the Final Geological Report.
6.	Mr. Abdul Ghaffar, Asstt:Store Keeper.	Assistance in Store Keeping of the relevant Store items of the Project.
7.	Mr. Ibrar Khan, Typist.	Assistance in Typing and despatch of official letters.
8.	Mr. Din Mohammad, Computer Data Entry Operator, MTL.	Typing/Printing and Graphic work on the Computer of the final Geological Report.
9.	Mr. Farooq Shah, Junior Clerk.	Typing of the manuscript of the report on Computer.

EXECUTIVE SUMMARY

This report describes the geological investigations for raw materials i.e Limestone and Clay deposits in various parts of N.W.F.P. for basing cement plants.

The study was carried out by S.D.A.Mineral wing under a PCII scheme namely "Survey and Exploration of Limestone and Clay deposits for basing cement plants in various parts of N.W.F.P to facilitate joint ventures in Mineral and Industrial sectors".

The Limestone and Clay deposits in the following areas were geologically investigated.

1. Daru Khula area Nizampur district Nowshera.
2. Shamozaï Babuzai area Katlang district Mardan
3. Banda Chashma Kirri Khisor and Kotla Lodian area D.I.Khan.
4. Palai area Malakand.
5. Tangi and surrounding areas district Charsadda.
6. Gadwallian area district Haripur.
7. Lachi area district Kohat.

Geological maps of these deposits were prepared on different scales. Rock/Chip and grab samples were collected from these deposits and were studied chemically and Petrographically. Core and Auger drilling was carried out in Limestone and Clay deposits at Daru Khula area Nizampur and Shamozaï-Babuzai area Katlang and thus the following targets which were envisaged in the PCII scheme were achieved with in the scheduled time period of two years.

- | | | |
|----|---|----------|
| 1. | Geological Mapping of Limestone and Clay deposits along with X-sections on scale 1:50,000 and 1:10,000. | |
| 2. | Collection of Grab,Rock/Chip samples | 1000 Nos |
| 3. | Bulk Samples | 20 Tones |
| 4. | Trenching/Pitting | 70 Nos |
| 5. | Petrographic Studies | 200 Nos |
| 6. | Chemical Analysis | 800 Nos |

7.	Core Drilling in Limestone	1000 Mtrs
8.	Core Drilling in Clay	300 Mtrs
9.	Auger Drilling in Clay	200 Mtrs

The Limestone and Clay deposits in most of the above mentioned areas are suitable for cement manufacturing.

Beside the best quality and sufficient quantity of raw materials, water and other infrastructure like roads, electricity etc are also available nearby to all the afore mentioned areas.

The Raw Materials at Daru Khula area Nizampur and Shamozaï - Babuzai area Katlang have been recommended for installation of cement plants of 3000 T.P.D. capacity in these areas, while the other areas have been recommended for detailed exploration, including detailed mapping, sampling and core drilling.

INTRODUCTION:-

The main raw materials used in cement manufacturing are Limestone (CaCo₃) and Clay.

The portland cement of standard specification contains 60-70 percent CaO, 20-25 percent SiO₂, 5-12 percent Al₂O₃ + Fe₂O₃, and MgO always less than 5 percent.

The North West Frontier Province (NWFP) is bestowed with extensive deposits of suitable grade of Limestone and clay which are used for the manufacture of portland cement.

Keeping in view the keen interest of the Chief Minister NWFP which he showed during his briefing by SDA, the Mineral Wing of Sarhad Development Authority launched a program of initial Geological Survey and Exploration of Limestone and Clay Deposits for basing cement plants in various parts of NWFP to facilitate joint ventures in Mineral and Industrial Sectors.

The Limestone and Clay deposits in the following areas were initially surveyed and sampled.

All the samples collected were submitted to the Mineral Testing Laboratory SDA Peshawar for chemical and petrographic studies.

1. Daru Khula area Nizampur District Nowshera.
2. Shamozaï-Babuzai area Katlang District Mardan.
3. Banda Chashma Kirri Khisor Kotla Lodian and Band Korai areas D.I.Khan.
4. Palai area Malakand.
5. Tangi and surrounding area District, Charsadda.
6. Gadwalian area District Haripur.
7. Lachi area District Kohat.

Based on the encouraging results achieved from the initial Survey a PC-II scheme namely "Survey and Exploration of Limestone and Clay deposits for Basing Cement Plants in various parts of NWFP" was approved by the Government with a total cost of Rs.10.00 millions.

It was envisaged in the PC-II scheme that areas of good quality and sufficient quantity of Limestone and Clay deposits in various parts of NWFP should be explored for basing cement plants with the following targets along with 1300 meters Core and 200 meters Auger drilling in Lime stone and Clay deposits at Daru Khula area Nizampur district Nowshera and Shamozaï- Babuzai area Katlang district Mardan.

- | | | |
|----|---|---------------|
| 1. | Geological Mapping of Limestone and Clay deposits along with X-sections on scale 1:50,000 and 10,000. | |
| 2. | Collection of Grab, Rock and Chip samples from Limestone and Clay deposits. | = 1000 Nos |
| 3. | Bulk samples. | = 20 tones |
| 4. | Trenching/Pitting. | = 70 Nos |
| 5. | Petrographic studies. | = 200 Nos |
| 6. | Chemical analysis. | = 800 Nos |
| 7. | Core drilling in Limestone. | = 1000 meters |
| 8. | Core drilling in Clay. | = 300 meters |
| 9. | Auger drilling in Clay. | = 200 meters |

These targets have been achieved with in the schedule time period of 2 years and the Limestone and Clay deposits in the following areas were studied in detail

1. Daru Khula area Nizampur District Nowshera.
2. Shamozaï - Babozai area Katlang District Mardan.
3. Banda Chashma Kirri Khisor and Kotla Lodian areas District D.I.Khan.
4. Palai area Malakand Agency.
5. Tangi and surrounding areas District Charsadda.
6. Gadwallian area District, Haripur.
7. Lachi area - Kohat.

**LIMESTONE AND CLAY DEPOSITS
AT DARU KHULA AREA
NIZAMPUR
DISTRICT NOWSHERA N.W.F.P.**

1.

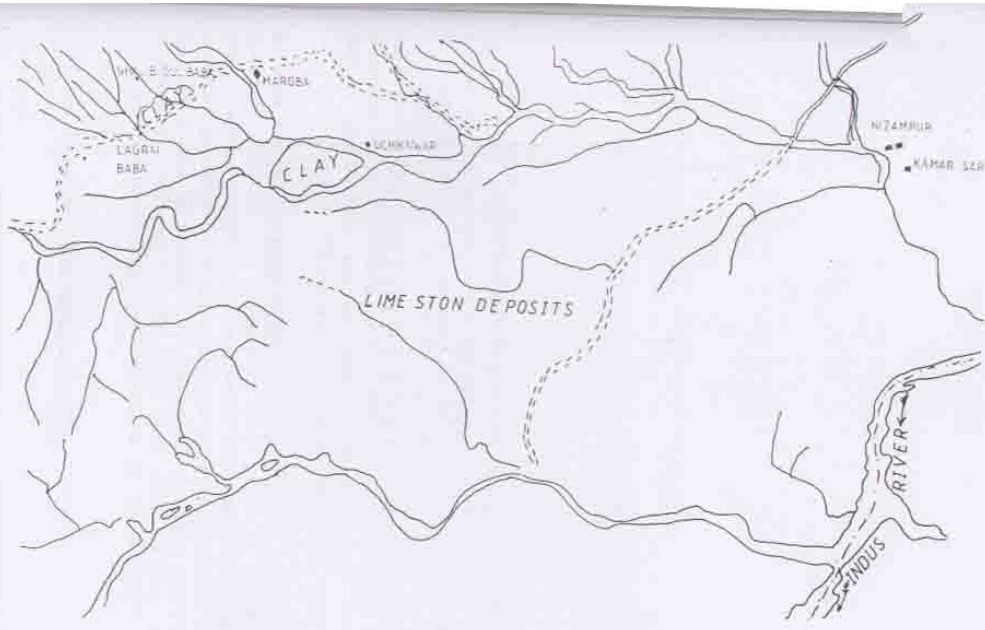
DARU KHULA AREA NIZAMPUR DISTRICT NOWSHERA

1.1 LOCATION AND ACCESSIBILITY

The Limestone and Clay deposits of Daru Khula area Nizampur are located on Topo sheet Nos. 43C/1, 43C/2, 38 O/13 and 38 O/14 Survey of Pakistan at a distance of about 5 kilometer from Nizampur Village in South direction on main Nizampur Kohat Road. The Limestone deposits are running in the East West direction while the clay deposits are present in foot hills of these rocks near Marooba and Ghalib baba areas

The area is approachable through metalled road and Kacha paths. The nearest Railway station is Khairabad, located at a distance of 32 kilometer from Nizampur. A location map of the area is prepared on scale 1:50,000.(fig 1.1)

Topographically the area is marked by rugged topography. The relief of the mountains ranges between 313 meters to 740 meters.



SCALE=1:50,000

LOCATION MAP OF LIME STONE AND CLAY DEPOSITS AT DARO KHULA NIZAMPUR DISTT NOWSHERA

FIG NO: 11



A VIEW OF LIMESTONE DEPOSITS
AT DARO KHULA AREA NIZAMPUR

South of Peshawar basin the Attock-Cherat range contain slates, less metamorphosed argillaceous arenaceous strata and subordinate Limestone. The southern margin of Attock-Cherat range consists of northerly dipping sequence of Limestone, quartzites and argillites. This southern sequence of Attock-Cherat range has faulted contact with unmetamorphosed mesozoic and early cenozoic strata of Kala Chita Range.

The rocks of Kala Chita range from a shallow marine sedimentary sequence of early Triassic to late Cretaceous overlain by Lockhart Limestone and patala formation.

The similarity of the Lockhart Limestone and patala formation in Kala Chita range and Attock-Cherat range strongly suggest that uplift and erosion of Attock-Cherat range and Kala Chita range occurred after the deposition of the late cretaceous kawagarh marl but prior to the deposition of paleocene Lockhart Limestone.

The Nizampur area is the North-West extension of the Kala Chita range.

It is mostly underlain by Sedimentary rocks which range in age from Jurassic to Quaternary. The Limestone is highly fossiliferous.

The General strike trend of the rocks is nearly East-West with a gentle to moderate dip towards South. The rocks in the investigated area are highly folded with a few thrust and strike slip faults.

Stratigraphically the following formations are identified in Nizampur area.

1. Surficial deposits.
2. Murree formation.
3. Patala formation.
4. Lockhart formation.
5. Kawagarh formation.
6. Lumshiwai formation.

Limestone of the Samana Suk, Lumshiwal, Lockhart and Patala formations are suitable for cement manufacturing and for argillaceous material the marl of Kawagarh formation and shale of Patala formation can be considered.

A General Geological map along with drill holes points locations in Limestone and clay deposits is prepared on scale 1:50,000 and 1:10,000 (fig 1.2 & 1.3).

--(7)--



LIMESTONE AT DARO KHULA NIZAMPUR

1

1.3 **CONTOUR SURVEY**

The Contour Survey of the Limestone deposits at Daru Khula area Nizampur was carried out with 25 meters contour interval on scale 1:500, 1:5000 and 1:10000 covering an area of about 3 Km² to locate the drilling points in the Limestone deposits at different localities to calculate the reserves and to plan the open cut mining in future. The contour Survey shall also be helpful to locate the plant site in the area. A Contour map of the Limestone deposits at Daru Khula area Nizampur on scale 1:10,000 is prepared (fig 1.5).



A VIEW OF PLAIN AREA AT THE FOOT HILLS OF LIMESTONE DEPOSITS
AT DARO KHULA AREA-NIZAMPUR
SUITABLE LOCATION FOR CEMENT PLANT.

The Limestone and Clay deposits at Daru Khula area were sampled and a total of 68 Nos chip/rock samples were collected from Limestone deposits and 14 Nos clay samples were collected for chemical and petrographic studies.

The analysis results of these samples are favorable for cement manufacturing as they are high in CaO content and low in MgO and other harmful elements.

A sample location map of Limestone and clay deposits is prepared on scale 1:10,000.(fig 1.4).

The following table No. 1.1 show the chemical analysis results of Limestone samples.

Table-1.1

**ANALYSIS RESULTS OF CHIP AND ROCK SAMPLES
COLLECTED FROM THE LIMESTONE DEPOSITS AT
DARU KHULA AREA NYZAMPUR**

S.NO.:	SAMPLE NO.:	CaO	MgO	SiO ₂	Fe ₂ O ₃	Al ₂ O ₃	K ₂ O	Na ₂ O	Cl	SO ₃	L.O.I
:	:	%	%	%	%	%	%	%	%	%	%
1.	LS-63	54.10	0.99	2	0.05	0.03	0.024	0.1	0.14	0.02	41.99
2.	LS-64	53.80	0.83	2.1	0.04	0.05	0.016	0.1	0.17	0.03	42.5
3.	LS-65	53.31	0.99	2.3	0.05	0.03	0.024	0.1	0.14	0.02	42.46
4.	LS-66	53.76	0.83	0.3	0.08	0.06	0.026	0.1	0.17	0.02	42.92
5.	LS-88	51.00	0.36	4.2	0.37	0.5	0.06	0.12	0.17	0.13	42.71
6.	LS-89	49.50	0.66	6.82	0.45	0.38	0.08	0.12	0.21	0.2	41.2
7.	LS-90	51.07	0.5	3.5	0.41	0.55	0.05	0.13	0.17	0.18	43
8.	LS-91	49.95	0.66	6.5	0.38	0.11	0.08	0.13	0.21	0.2	41.5
9.	LS-92	51.74	0.72	2.66	0.22	0.42	0.02	0.1	0.21	0.14	43.2
10.	LS-93	51.52	0.71	2.65	0.28	0.5	0.06	0.11	0.21	0.18	43.39
11.	LSN- 226	53.08	0.56	0.51	0.37	2.18	0.08	0.02	0.24	0.26	42.21
12.	LSN- 227	53.26	0.36	0.56	0.34	1.98	0.09	0.02	0.28	0.27	42.24

S.NO.:	SAMPLE NO.:	CaO	MgO	SiO2	Fe2O3	Al2O3	K2O	Na2O	Cl	SO3	L.O.I
13.	LSN- 228	51.96	0.66	0.65	0.12	1.38	0.08	0.01	0.80	0.75	42.67
14.	LSN- 229	51.52	0.72	0.90	0.15	0.20	0.06	0.02	0.79	0.74	43.23
15.	LSN- 230	48.83	2.15	1.29	0.08	0.80	0.08	0.02	0.75	0.82	43.20
16.	LSN- 231	50.17	0.82	1.25	0.12	1.12	0.06	0.02	0.82	0.82	42.85
17.	LSN- 232	50.62	0.77	1.14	0.17	0.66	0.08	0.01	0.79	0.80	43.57
18.	LSN- 233	51.52	0.77	0.90	0.11	2.08	0.08	0.01	0.18	0.49	43.33
19.	LSN- 246	51.29	0.63	0.87	0.07	0.56	0.06	0.01	0.46	0.76	43.74
20.	LSN- 247	50.62	0.58	1.85	0.31	0.20	0.07	0.01	0.64	0.85	43.72
21.	LSN- 248	48.60	1.61	1.62	0.11	0.22	0.06	0.01	1.20	1.23	43.74
22.	LSN- 249	50.84	0.56	1.28	0.11	0.32	0.06	0.01	0.82	0.92	43.83
23.	LSN- 250	51.52	0.63	0.72	0.07	0.96	0.06	0.01	0.68	0.70	44.02
24.	LSN- 251	50.62	0.49	0.64	0.15	1.62	0.08	0.01	0.66	0.68	44.12
25.	LSN- 252	45.92	1.74	1.52	0.22	1.30	0.07	0.03	1.64	1.66	43.39
26.	LSN- 253	47.04	1.61	1.46	0.20	0.88	0.06	0.02	1.12	1.22	43.71
27.	LSN- 254	49.50	0.76	1.40	0.27	1.92	0.08	0.03	0.80	0.96	43.40
28.	LSN- 255	49.05	0.76	1.56	0.41	2.20	0.09	0.06	0.84	0.89	42.98
29.	LSN- 206	53.53	0.66	0.44	0.10	0.99	0.14	0.02	0.28	0.20	43.29
30.	LSN- 207	53.00	0.99	0.92	0.21	0.95	0.13	0.03	0.20	0.18	42.95
31.	LSN- 208	53.20	0.76	0.24	0.05	0.88	0.16	0.02	0.21	0.15	42.96
32.	LSN- 209	53.18	0.66	0.60	0.04	0.56	0.13	0.02	0.18	0.19	43.96
33.	LSN- 210	54.00	0.62	0.40	0.04	0.02	0.10	0.02	0.16	0.17	43.49
34.	LSN- 211	53.76	0.60	0.65	0.12	0.20	0.11	0.02	0.13	0.14	43.37
35.	LSN- 212	53.68	0.62	0.60	0.08	0.75	0.14	0.02	0.15	0.16	43.56
36.	LSN- 213	53.32	0.66	0.58	0.04	0.48	0.16	0.03	0.17	0.18	43.67
37.	LSN- 214	53.50	0.68	0.40	0.08	0.31	0.14	0.02	0.07	0.08	43.49
38.	LSN- 215	53.76	0.60	0.46	0.08	0.87	0.16	0.02	0.12	0.11	43.09
39.	LSN- 216	53.32	0.66	1.28	0.05	0.31	0.14	0.02	0.15	0.18	42.72
40.	LSN- 217	53.53	0.72	0.64	0.07	0.25	0.14	0.03	0.16	0.18	43.06
41.	LSN- 218	52.86	1.39	0.56	0.07	0.88	0.14	0.03	0.21	0.19	43.63
42.	LSN- 219	53.43	0.65	0.55	0.07	0.55	0.14	0.02	0.20	0.13	42.09
43.	LSN- 220	52.41	0.65	0.48	0.10	0.58	0.16	0.03	0.21	0.15	43.04
44.	LSN- 221	53.76	0.66	0.58	0.05	0.62	0.17	0.02	0.20	0.18	42.88
45.	LSN- 222	53.53	0.99	0.60	0.05	0.56	0.14	0.02	0.21	0.15	43.32
46.	LSN- 223	53.58	0.74	1.24	0.04	0.60	0.16	0.02	0.21	0.18	42.90
47.	LSN- 224	53.76	0.70	0.85	0.11	0.78	0.14	0.02	0.20	0.20	43.11
48.	LSN- 225	49.95	1.98	3.18	0.15	0.69	0.14	0.02	0.24	0.22	42.40
49.	LSN- 186	52.10	0.82	1.82	0.07	0.99	0.18	0.12	0.19	0.23	42.66
50.	LSN- 187	52.88	0.82	1.82	0.07	0.23	0.18	0.10	0.18	0.21	42.82
51.	LSN- 188	52.88	0.82	1.78	0.11	0.57	0.18	0.04	0.17	0.20	42.79
52.	LSN- 189	53.00	0.66	1.44	0.06	0.79	0.17	0.04	0.18	0.22	42.81
53.	LSN- 190	53.60	0.66	1.30	0.06	0.53	0.18	0.06	0.16	0.24	42.68
54.	LSN- 191	53.00	0.91	1.74	0.07	0.86	0.18	0.03	0.15	0.21	42.30
55.	LSN- 192	53.30	0.74	1.96	0.08	0.53	0.17	0.03	0.14	0.20	42.20
56.	LSN- 193	52.70	0.66	2.44	0.10	0.09	0.20	0.04	0.17	0.19	42.74

S.NO.:	SAMPLE NO.:	CaO	MgO	SiO2	Fe2O3	Al2O3	K2O	Na2O	Cl	SO3	L.O.I
:	:	%	%	%	%	%	%	%	%	%	%
57.	LSN- 194	53.14	0.44	1.92	0.08	0.69	0.21	0.03	0.16	0.21	42.54
58.	LSN- 195	53.12	0.76	1.26	0.05	0.65	0.20	0.03	0.15	0.23	42.71
59.	LSN- 196	52.65	0.63	2.42	0.07	0.53	0.17	0.03	0.14	0.20	42.75
60.	LSN- 197	53.00	0.82	1.32	0.08	0.14	0.18	0.03	0.13	0.22	43.31
61.	LSN- 198	52.20	0.66	1.54	0.05	1.00	0.18	0.04	0.15	0.19	43.05
62.	LSN- 199	53.65	0.66	1.62	0.04	0.09	0.20	0.03	0.14	0.18	42.97
63.	LSN- 200	52.46	0.66	2.38	0.05	0.69	0.21	0.03	0.14	0.17	42.64
64.	LSN- 201	53.00	0.82	1.42	0.10	0.50	0.20	0.03	0.13	0.20	43.07
65.	LSN- 202	53.00	0.66	1.68	0.04	0.53	0.18	0.03	0.12	0.19	43.09
66.	LSN- 203	52.93	0.74	1.84	0.08	0.86	0.18	0.04	0.13	0.22	42.34
67.	LSN- 204	52.53	0.66	1.86	0.07	0.64	0.21	0.04	0.12	0.21	43.07
68.	LSN- 205	52.20	0.82	1.62	0.06	0.79	0.20	0.03	0.14	0.20	43.42

1.5 PETROGRAPHY

Thin sections of the samples (LS-63 to LS-66), and LS-88 to LS-93) were prepared and studied under the microscope to find the exact type of Limestone and also identifying the associated minerals. The microscopic study is also aided by staining tests.

Detail of the petrographic studies is as follows.

1. SAMPLE NO LS-63

Calcite, quartz, feldspar

This section show a very fine grained Limestone composed entirely of microscopic size. Some of the grains are found in the form of aggregate.

Veinlets of partially re-crystallized grains are of various thicknesses. The rock is also fossiliferous and amorphous in nature.

Few quartz and feldspar grains are present.

Rock Name:- Lime stone.

2. SAMPLE NO. LS-64.

The texture and composition of this Limestone rock is almost identical with the sample No. (LS-64), but in this case the grains are found in patches.

Bioclasts and corals are commonly present, but no silicate mineral is found.

Rock Name:- Lime stone.

3. SAMPLE NO. LS-65

Some of the recrystallized calcite grains show double set of cleavages. Imprints of the few ancient fossils are also observed. Veinlets of partially re-crystallized grains are cross cutting the section. The rock is lime stone in composition.

Sericite grains are also observed.

4. SAMPLE NO. LS-66

The ooids are showing rather poorly preserved concentric structure.

Calcite and dolomite grains comprises the small veinlets which are comparatively larger in size. Most of the grains are microcrystalline. Bioclasts are also not uncommon.

The samples (LS-88 to LS-93) have the following petrographic description.

The rock studied are compositionally Limestone based on petrographic studies. The calcite is dominant in quantity along with some dolomite, quartz, muscovite, sericite, orthoclase and opaque minerals. These rock are also fossiliferous in nature.

Mostly the calcite are fine grained almost of microspar size. The cementing material is commonly sparite although unfilled pore-spaces remain in some case. They are variable in size usually found in cluster form, calcite are usually occur in the form of small veinlets also of variable thicknesses. In some cases they are cross-cutting each other. Slightly curve veinlets are also not un common.

Partially recrystallized grains are also found, (LS-89). Some broken quartz grains are also present.

The neomorphism refer to all transformations between a mineral and the same mineral, or an other mineral of the same general composition. The terms microspar and pseudospar are used for crystal mosaic of neomorphic origin having a mean size of between 4 & 10 um respectively, (LS-93).

1.6 CORE DRILLING IN LIMESTONE DEPOSITS AT DARU KHULA AREA NIZAMPUR.

Based on initial Exploration and analysis results the Limestone deposits at Daru Khula Nizampur were recommended for Core drilling. A total of 500 meters core drilling was made through 8 nos holes in different localities of these deposits

All the Cores collected through core drilling were sampled in a way that 1 No sample was prepared from the core of 2.5 meters length of core and thus 154 Nos samples were prepared from all the cores. These samples were analyzed for CaO, MgO, Al₂O₃, Fe₂O₃, SiO₂, Na₂O, K₂O, SO₃, Cl and L.O.I. The analysis results of these samples collected through core drilling are shown in the following Table No 1.2. (LN-1LN-8 are Core drill Holes Nos)

TABLE NO 1.2

ANALYSIS RESULTS OF SAMPLES COLLECTED THROUGH CORE DRILLING IN THE LIME STONE DEPOSITS AT DARU KHULLA AREA - NIZAMPUR

S.NO.	SAMPLE NO	CaO %	MgO %	AL ₂ O ₃ %	Fe ₂ O ₃ %	SiO ₂ %	Na ₂ O %	K ₂ O %	SO ₃ %	Cl %	L.O.I %
1	LN1- 1	51.52	0.33	0.86	0.12	2.62	0.05	0.010	0.47	0.35	42.43
2	LN1- 2	51.52	0.49	0.88	0.08	2.24	0.04	0.010	0.25	0.33	43.29
3	LN1- 3	51.52	0.99	0.82	0.14	2.62	0.04	0.020	0.31	0.31	42.05
4	LN1- 4	50.28	0.61	0.90	0.18	2.90	0.03	0.020	0.39	0.34	43.04
5	LN1- 5	50.62	0.66	0.94	0.08	2.34	0.04	0.020	0.28	0.32	42.96
6	LN1- 6	48.38	0.66	0.82	0.10	3.54	0.04	0.020	0.30	0.30	43.92
7	LN1- 7	49.14	0.66	0.87	0.10	3.54	0.04	0.040	0.35	0.31	43.15
8	LN1- 8	51.74	0.49	0.81	0.15	1.70	0.04	0.020	0.37	0.28	42.74
9	LN1- 9	51.32	0.58	0.82	0.12	2.72	0.04	0.020	0.34	0.29	42.76
10	LN1- 10	51.04	0.66	0.85	0.11	3.36	0.04	0.030	0.30	0.27	43.00
11	LN1- 11	49.50	0.63	0.80	0.15	3.54	0.04	0.030	0.27	0.24	43.33
12	LN1- 12	50.40	0.66	0.79	0.21	3.56	0.04	0.020	0.25	0.26	42.40

S.NO.	SAMPLE NO	CaO	MgO	Al2O3	Fe2O3	SiO2	Na2O	K2O	SO3	Cl	L.O.I
13	LN2- 13	52.04	0.59	0.89	0.08	2.64	0.04	0.020	0.24	0.25	43.03
14	LN2- 14	53.04	0.49	0.82	0.07	4.82	0.06	0.030	0.22	0.30	41.93
15	LN2- 15	50.60	0.82	0.88	0.11	3.10	0.05	0.020	0.30	0.29	41.98
16	LN2- 16	50.28	0.74	0.67	0.08	1.92	0.05	0.020	0.19	0.28	44.41
17	LN2- 17	52.76	0.59	0.69	0.05	1.58	0.04	0.010	0.20	0.24	43.19
18	LN2- 18	51.60	0.66	0.84	0.04	1.12	0.06	0.010	0.23	0.23	43.54
19	LN2- 19	52.86	0.49	0.79	0.05	1.90	0.08	0.010	0.19	0.27	43.26
20	LN2- 20	50.17	0.58	0.80	0.04	1.88	0.04	0.020	0.20	0.24	44.48
21	LN2- 21	48.80	0.49	0.91	0.05	1.98	0.04	0.010	0.27	0.33	44.42
22	LN2- 22	49.95	0.98	0.90	0.08	1.94	0.04	0.010	0.26	0.34	44.20
23	LN2- 23	50.17	0.66	0.67	0.07	1.92	0.06	0.010	0.25	0.31	43.77
24	LN2- 24	48.16	0.49	0.65	0.04	4.44	0.04	0.010	0.28	0.30	44.30
25	LN2- 25	51.55	0.82	0.69	0.05	2.20	0.04	0.020	0.29	0.29	43.33
26	LN2- 26	49.04	0.58	0.82	0.08	4.06	0.04	0.010	0.27	0.30	43.57
27	LN2- 27	51.44	0.49	0.81	0.11	2.52	0.04	0.020	0.25	0.28	43.29
28	LN2- 28	49.71	0.54	0.88	0.07	2.86	0.04	0.010	0.26	0.31	43.76
29	LN2- 29	50.40	0.54	0.87	0.14	2.22	0.04	0.010	0.28	0.29	43.64
30	LN2- 30	53.00	0.56	0.82	0.11	0.62	0.03	0.020	0.29	0.27	43.32
31	LN3- 1	52.64	0.82	0.61	0.05	2.26	0.06	0.020	0.30	0.27	42.48
32	LN3- 2	52.86	0.66	0.59	0.05	2.08	0.07	0.020	0.28	0.28	42.43
33	LN3- 3	51.96	0.64	0.56	0.07	2.58	0.11	0.010	0.26	0.30	42.81
34	LN3- 4	52.48	0.56	0.49	0.04	2.00	0.07	0.020	0.25	0.24	43.26
35	LN3- 5	52.86	0.51	0.51	0.04	2.36	0.07	0.010	0.27	0.23	41.88
36	LN3- 6	52.64	0.66	0.50	0.05	2.70	0.08	0.020	0.28	0.22	42.37
37	LN3- 7	52.64	0.58	0.51	0.05	2.96	0.09	0.010	0.24	0.21	42.09
38	LN3- 8	53.76	0.54	0.48	0.05	2.42	0.06	0.010	0.40	0.25	41.66
39	LN3- 9	53.08	0.49	0.48	0.03	2.66	0.06	0.010	0.38	0.24	41.98
40	LN3- 10	54.43	0.51	0.47	0.04	1.50	0.07	0.010	0.32	0.23	41.92
41	LN3- 11	53.76	0.54	0.48	0.03	1.88	0.07	0.010	0.31	0.27	42.44
42	LN3- 12	53.43	0.51	0.47	0.04	1.54	0.07	0.010	0.29	0.26	42.81
43	LN3- 13	54.65	0.51	0.46	0.03	1.62	0.07	0.020	0.41	0.20	41.69
44	LN3- 14	53.08	0.63	0.48	0.03	2.18	0.08	0.010	0.37	0.29	42.11
45	LN3- 15	53.65	0.66	0.47	0.06	2.30	0.09	0.010	0.36	0.27	41.53
46	LN3- 16	49.28	0.63	0.72	0.05	5.36	0.09	0.010	0.32	0.38	41.73
47	LN3- 17	53.76	0.56	0.49	0.06	2.10	0.09	0.020	0.31	0.25	41.83
48	LN3- 18	54.65	1.02	0.45	0.06	1.60	0.08	0.020	0.30	0.24	41.30
49	LN4- 1	53.24	0.66	0.42	0.08	1.98	0.09	0.010	0.27	0.22	42.63
50	LN4- 2	53.89	0.61	0.40	0.07	1.10	0.07	0.010	0.25	0.23	42.54
51	LN4- 3	53.00	0.86	0.39	0.11	2.00	0.09	0.010	0.21	0.20	42.67
52	LN4- 4	53.22	0.82	0.37	0.05	1.44	0.08	0.010	0.20	0.18	42.95
53	LN4- 5	53.12	0.67	0.45	0.09	1.50	0.08	0.005	0.18	0.23	42.85
54	LN4- 6	53.44	0.43	0.50	0.07	1.52	0.09	0.004	0.17	0.24	42.99
55	LN4- 7	53.44	0.49	0.54	0.03	1.50	0.07	0.004	0.16	0.26	42.68
56	LN4- 8	52.76	0.49	0.62	0.04	2.46	0.07	0.004	0.17	0.25	42.53

S.NO.	SAMPLE NO	CaO %	MgO %	Al2O3 %	Fe2O3 %	SiO2 %	Na2O %	K2O %	SO3 %	Cl %	L.O.I %
57	LN4- 9	53.12	0.53	0.41	0.04	1.58	0.08	0.008	0.18	0.21	42.85
58	LN4- 10	52.08	0.56	0.58	0.03	1.94	0.08	0.010	0.20	0.19	43.76
59	LN4- 11	53.56	0.48	0.40	0.04	1.66	0.07	0.008	0.21	0.20	42.68
60	LN4- 12	53.24	0.53	0.45	0.06	0.90	0.08	0.010	0.19	0.21	42.91
61	LN4- 13	53.24	0.56	0.52	0.04	1.30	0.08	0.008	0.18	0.22	42.85
62	LN4- 14	53.24	0.61	0.56	0.13	1.50	0.08	0.010	0.16	0.26	42.65
63	LN4- 15	52.88	0.56	0.64	0.09	1.80	0.09	0.010	0.18	0.28	42.63
64	LN4- 16	53.34	0.51	0.44	0.10	0.96	0.08	0.010	0.17	0.22	43.13
65	LN5- 1	52.64	0.49	0.140	0.18	2.64	0.08	0.020	0.27	0.26	42.08
66	LN5- 2	50.62	0.76	0.650	0.29	4.66	0.09	0.030	0.17	0.31	42.00
67	LN5- 3	52.41	0.49	0.570	0.25	2.24	0.08	0.010	0.22	0.28	42.93
68	LN5- 4	52.64	0.49	0.090	0.25	2.76	0.10	0.020	0.20	0.31	42.86
69	LN5- 5	52.86	0.99	0.690	0.18	1.88	0.09	0.020	0.15	0.31	42.03
70	LN5- 6	50.72	1.49	0.420	0.18	2.49	0.08	0.020	0.28	0.28	43.33
71	LN5- 7	50.62	1.09	0.870	0.29	2.82	0.10	0.040	0.14	0.24	43.28
72	LN5- 8	52.19	0.58	0.310	0.18	2.16	0.08	0.020	0.16	0.31	43.21
73	LN5- 9	51.74	0.49	0.790	0.25	2.70	0.08	0.020	0.17	0.31	42.80
74	LN5- 10	49.60	0.58	0.009	0.18	4.76	0.08	0.010	0.28	0.28	42.50
75	LN5- 11	49.05	1.32	0.790	0.14	7.36	0.08	0.020	0.18	0.28	40.55
76	LN5- 12	48.14	1.65	0.690	0.18	5.22	0.10	0.020	0.29	0.31	41.84
77	LN5- 13	48.04	0.99	0.660	0.18	8.18	0.06	0.100	0.27	0.24	40.12
78	LN5- 14	49.38	0.82	0.420	0.18	5.14	0.09	0.030	0.28	0.28	42.06
79	LN5- 15	50.17	0.66	0.500	0.18	4.10	0.09	0.040	0.19	0.28	42.10
80	LN5- 16	49.38	0.66	0.280	0.18	3.68	0.08	0.040	0.29	0.31	42.90
81	LN6- 1	54.88	0.58	0.28	0.29	0.96	0.45	0.030	0.25	0.20	41.35
82	LN6- 2	51.52	1.32	0.02	0.29	3.04	0.44	0.060	0.21	0.26	41.49
83	LN6- 3	54.65	0.82	0.03	0.29	1.42	0.48	0.030	0.19	0.23	41.51
84	LN6- 4	52.41	0.82	0.04	0.14	3.26	0.44	0.040	0.18	0.20	41.95
85	LN6- 5	52.41	0.82	0.06	0.14	1.60	0.48	0.030	0.21	0.22	42.69
86	LN6- 6	51.52	1.49	0.57	0.18	2.40	0.47	0.040	0.20	0.19	42.09
87	LN6- 7	51.84	0.66	0.23	0.18	1.72	0.48	0.020	0.14	0.21	43.01
88	LN6- 8	51.95	0.66	0.08	0.18	2.66	0.43	0.020	0.12	0.20	43.09
89	LN6- 9	51.40	0.82	0.42	0.29	2.30	0.48	0.030	0.18	0.17	42.88
90	LN6- 10	51.40	0.66	0.09	0.18	2.18	0.51	0.020	0.22	0.19	42.46
91	LN6- 11	52.29	0.66	0.08	0.10	2.46	0.47	0.020	0.20	0.16	42.17
92	LN6- 12	52.96	0.82	0.06	0.07	1.30	0.48	0.020	0.21	0.21	42.32
93	LN6- 13	52.96	0.82	0.07	0.10	0.88	0.49	0.020	0.16	0.16	42.53
94	LN6- 14	51.17	0.66	0.14	0.10	3.48	0.51	0.020	0.18	0.15	42.29
95	LN6- 15	53.19	0.66	0.23	0.07	1.30	0.49	0.030	0.17	0.18	42.42
96	LN6- 16	52.74	0.82	0.09	0.10	2.30	0.47	0.020	0.14	0.22	41.80
97	LN6- 17	52.50	0.66	0.42	0.14	2.88	0.49	0.040	0.15	0.23	42.14
98	LN6- 18	52.52	0.66	0.65	0.07	0.82	0.49	0.020	0.18	0.20	42.93
99	LN6- 19	50.17	1.32	0.56	0.14	2.40	0.44	0.030	0.13	0.17	42.93
100	LN6- 20	51.41	0.66	1.03	0.07	2.90	0.48	0.020	0.12	0.14	42.62

S.NO.	SAMPLE NO	CaO	HgO	Al2O3	Fe2O3	SiO2	Na2O	K2O	SO3	Cl	L.O.I
		%	%	%	%	%	%	%	%	%	%
101	LN6- 21	50.62	1.49	0.56	0.10	2.98	0.53	0.040	0.11	0.18	42.92
102	LN6- 22	51.17	0.74	0.14	0.03	2.98	0.47	0.030	0.16	0.19	43.04
103	LN6- 23	51.16	0.66	0.08	0.07	2.78	0.51	0.030	0.13	0.17	43.49
104	LN6- 24	50.84	0.66	0.28	0.07	3.26	0.49	0.030	0.12	0.16	42.59
105	LN7- 1	51.52	0.66	0.003	0.73	4.06	0.44	0.07	0.18	0.13	41.50
106	LN7- 2	53.76	0.82	0.140	0.36	1.42	0.45	0.03	0.10	0.09	41.70
107	LN7- 3	53.50	0.66	0.140	0.36	2.14	0.40	0.02	0.11	0.10	41.88
108	LN7- 4	53.98	0.66	0.420	0.29	1.56	0.45	0.02	0.13	0.11	41.98
109	LN7- 5	52.64	0.66	0.010	0.29	3.22	0.40	0.03	0.12	0.12	41.55
110	LN7- 6	52.64	0.82	0.280	0.36	3.26	0.45	0.03	0.17	0.11	41.34
111	LN7- 7	50.84	0.82	0.090	0.36	5.24	0.41	0.02	0.16	0.13	40.78
112	LN7- 8	51.96	0.77	0.370	0.69	3.46	0.43	0.02	0.15	0.12	40.71
113	LN7- 9	53.98	0.74	0.110	0.36	1.32	0.47	0.03	0.13	0.09	41.62
114	LN7- 10	53.98	0.82	0.280	0.18	1.02	0.40	0.04	0.13	0.08	41.83
115	LN7- 11	53.08	0.82	0.140	0.36	2.42	0.43	0.02	0.12	0.09	40.62
116	LN7- 12	51.74	0.71	0.200	0.21	3.66	0.39	0.02	0.14	0.14	40.82
117	LN7- 13	52.64	0.74	0.140	0.29	4.38	0.45	0.04	0.12	0.11	40.44
118	LN7- 14	51.52	0.79	0.480	0.10	3.40	0.40	0.04	0.16	0.14	41.06
119	LN7- 15	52.19	0.82	0.009	0.32	4.12	0.39	0.02	0.14	0.12	39.96
120	LN7- 16	52.86	1.16	0.280	0.18	2.42	0.42	0.02	0.13	0.11	40.87
121	LN7- 17	50.84	0.77	0.009	0.36	5.68	0.51	0.03	0.15	0.14	40.02
122	LN7- 18	53.76	0.82	0.280	0.36	1.44	0.43	0.02	0.10	0.10	42.17
123	LN7- 19	53.88	0.82	0.004	0.29	1.10	0.41	0.02	0.09	0.09	42.02
124	LN7- 20	51.52	0.66	0.280	0.29	2.44	0.38	0.03	0.15	0.12	42.34
125	LN7- 21	52.86	0.74	0.004	0.10	1.62	0.40	0.02	0.12	0.10	42.23
126	LN7- 22	53.31	0.82	0.420	0.10	1.00	0.38	0.02	0.10	0.10	42.75
127	LN7- 23	51.96	0.91	0.140	0.36	3.50	0.49	0.04	0.14	0.13	41.53
128	LN7- 24	52.19	0.66	0.003	0.25	2.04	0.43	0.02	0.11	0.12	42.84
129	LN8- 1	52.41	0.82	0.28	0.14	2.08	0.43	0.06	0.26	0.29	41.93
130	LN8- 2	51.52	1.16	0.22	0.18	2.60	0.45	0.05	0.25	0.27	41.77
131	LN8- 3	50.40	1.32	0.28	0.29	2.64	0.47	0.03	0.27	0.24	42.24
132	LN8- 4	52.64	1.16	0.35	0.14	1.72	0.44	0.06	0.22	0.19	42.08
133	LN8- 5	50.40	0.99	0.35	0.07	3.08	0.43	0.03	0.28	0.20	41.67
134	LN8- 6	52.64	0.80	0.28	0.07	2.54	0.43	0.04	0.24	0.22	42.00
135	LN8- 7	51.96	1.16	0.42	0.06	1.28	0.41	0.03	0.27	0.21	42.92
136	LN8- 8	53.76	0.66	0.22	0.10	0.82	0.47	0.02	0.26	0.23	42.41
137	LN8- 9	52.64	0.66	0.28	0.07	2.44	0.41	0.03	0.24	0.20	41.94
138	LN8- 10	53.08	0.82	0.28	0.07	1.60	0.44	0.02	0.19	0.22	42.59
139	LN8- 11	52.41	0.99	0.35	0.08	1.54	0.44	0.02	0.25	0.19	42.22
140	LN8- 12	52.19	0.82	0.14	0.08	1.74	0.43	0.01	0.24	0.21	42.15
141	LN8- 13	52.41	0.99	0.42	0.06	1.32	0.48	0.01	0.22	0.18	42.05
142	LN8- 14	50.95	1.32	0.28	0.10	2.72	0.47	0.01	0.21	0.16	42.24
143	LN8- 15	45.80	2.98	0.42	0.07	7.86	0.45	0.04	0.20	0.14	40.64

S.NO.	SAMPLE NO	CaO %	MgO %	Al ₂ O ₃ %	Fe ₂ O ₃ %	SiO ₂ %	Na ₂ O %	K ₂ O %	SO ₃ %	Cl %	L.O.I %
144	LN8- 16	46.02	2.48	0.14	0.06	8.14	0.44	0.04	0.22	0.16	40.36
145	LN8- 17	51.29	1.16	0.42	0.06	4.16	0.43	0.03	0.23	0.15	41.84
146	LN8- 18	50.60	0.82	0.35	0.07	3.66	0.47	0.03	0.21	0.18	41.81
147	LN8- 19	51.29	0.99	0.35	0.03	4.32	0.45	0.03	0.20	0.19	41.33
148	LN8- 20	51.24	1.32	0.42	0.03	3.32	0.43	0.03	0.21	0.17	41.63
149	LN8- 21	49.92	1.32	0.28	0.05	3.58	0.45	0.03	0.24	0.16	42.22
150	LN8- 22	51.96	1.49	0.42	0.03	2.12	0.51	0.02	0.23	0.14	42.46
151	LN8- 23	51.52	0.82	0.42	0.03	2.40	0.48	0.02	0.21	0.18	42.31
152	LN8- 24	51.62	0.66	0.28	0.03	2.62	0.44	0.02	0.19	0.22	42.79
153	LN8- 25	50.48	0.82	0.42	0.03	3.36	0.44	0.02	0.17	0.23	42.13
154	LN8- 26	52.86	0.74	0.14	0.06	1.56	0.56	0.02	0.18	0.22	42.61

-(19):-



DRILLING WORK IN PROGRESS AT HOLE NO-3 ON LIMESTONE DEPOSITS AT DARO KHULA AREA NIZAMPUR

1.7 LOGGING OF CORE DRILLING IN LIME STONE DEPOSITS AT DARU KHULA
AREA NIZAM PUR

Logs of Core drill holes drilled in the Limestone deposits at Daru Khula area Nizampur have been prepared on scale 1:300 along with the analysis results of the samples collected through core drilling.

Description of each Core drilled hole is as follows.

-(20):-

SARHAD DEVELOPMENT AUTHORITY
CORE DRILLING IN LIMESTONE
DEPOSITS AT DARU KHULA AREA
NIZAMPUR

PROJECT: SURVEY AND EXPLORATION OF LIMESTONE AND CLAY DEPOSITS FOR BASING CEMENT PLANTS IN NWFP.	HOLE NO. LN - 1
	CORE SIZE - NX

TOTAL BORE DEPTH 50 M	CORE RECOVERY 29.07 M	PERCENTAGE OF CORE RECOVERY 58.14 %
--------------------------	--------------------------	--

DATE: JAN:1996	LOGGED BY:	SELC PROJECT, SDA:-
----------------	------------	---------------------

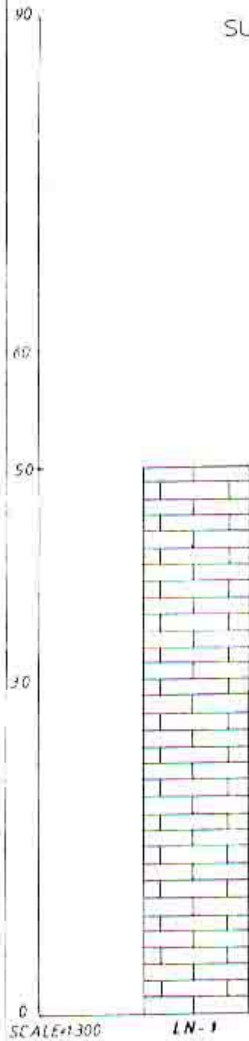
FROM(M)	TO (M)	DESCRIPTION
1.00	10.35	Limestone, crystalline, fine grained, compact, argillaceous, gravel, marl at the starting, highly fractured and jointed, fossils observed in core recovery, calcite veinlets are lenticular and translucent.
10.35	16.44	Limestone, compact, with calcite lenticular veinlets, vugs of calcite are also observed, fractures are filled with marly material, marl is brownish in color.
16.44	23.59	Limestone, fine grained spotted calcite grains, highly jointed, fractures are filled with marly material. At 19.52m to 19.92m limestone is silty. In few core recovery observed fossils.
23.59	31.04	Limestone, fine grained with lenticular veinlets, siliceous jointed and fractured, whitish streak heterogenous mixture of fine to coarse grained medium gray, observed minor vugs.
31.04	41.08	Limestone, crystalline heterogeneous mixture of fine to medium grained, jointed, fractures are filled with brownish color marly material medium gray with whitish streak.
41.08	44.00	Limestone, fine to medium grained with spotted calcite grains and thin calcite veinlets. Jointed & fractured with brownish color marly material siliceous.
44.00	50.00	Limestone, fine to medium grained, siliceous fossils observed in core recovery. Calcite veins are very thin and lenticular. Jointed & fractured, fractures are filled with marl brownish in color.

SARHAD DEVELOPMENT AUTHORITY



SURVEY AND EXPLORATION OF LIMESTONE AND
CLAY DEPOSITS IN N.W.F.P.

S. No.	Sample No.	CaO, %	MgO, %	Al ₂ O ₃ , %	Fe ₂ O ₃ , %	SiO ₂ , %	Na ₂ O, %	K ₂ O, %	SO ₃ , %	Cl, %	Loss, %
1	LN1-1	51.52	0.33	0.86	0.12	2.62	0.05	0.00	0.47	0.35	42.43
2	LN1-2	51.52	0.49	0.88	0.08	2.24	0.04	0.010	0.25	0.23	43.29
3	LN1-3	51.52	0.99	0.82	0.14	2.62	0.04	0.020	0.31	0.31	42.05
4	LN1-4	50.28	0.61	0.90	0.18	2.90	0.03	0.020	0.39	0.34	43.04
5	LN1-5	50.62	0.66	0.94	0.08	2.34	0.04	0.010	0.29	0.32	42.92
6	LN1-6	48.38	0.66	0.82	0.10	3.54	0.04	0.020	0.30	0.30	43.92
7	LN1-7	49.14	0.66	0.87	0.10	3.54	0.04	0.040	0.35	0.31	43.15
8	LN1-8	51.76	0.49	0.81	0.15	1.70	0.04	0.020	0.37	0.28	42.74
9	LN1-9	51.32	0.58	0.82	0.12	2.72	0.04	0.020	0.34	0.29	42.76
10	LN1-10	51.04	0.66	0.85	0.11	3.36	0.04	0.030	0.30	0.27	43.00
11	LN1-11	49.50	0.63	0.80	0.15	3.54	0.04	0.030	0.27	0.24	43.32
12	LN1-12	50.40	0.66	0.79	0.21	3.56	0.04	0.020	0.25	0.26	42.40
Average Values		51.77	0.61	0.84	0.12	2.89	0.03	0.02	0.32	0.30	42.91



GEO LOG OF CORE DRILL HOLE NO-1 AND ITS
CHEMICAL ANALYSIS NIZAMPUR AREA DIST:
NOWSHERA

SARHAD DEVELOPMENT AUTHORITY
CORE DRILLING IN LIMESTONE
DEPOSITS AT DARU KHULA AREA
NIZAMPUR

PROJECT: SURVEY AND EXPLORATION OF LIMESTONE AND CLAY DEPOSITS FOR BASING CEMENT PLANTS IN NWFP.	HOLE NO. LN - 2
	CORE SIZE - NX

TOTAL BORE DEPTH 50 M	CORE RECOVERY 44.90 M	PERCENTAGE OF CORE RECOVERY 89.8 %
--------------------------	--------------------------	---------------------------------------

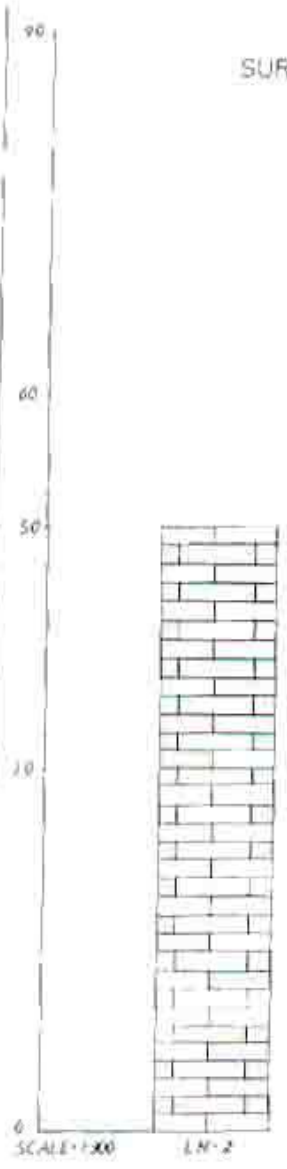
DATE: FEB: 1996	LOGGED BY:	SELC PROJECT, SDA:-
-----------------	------------	---------------------

FROM(M)	TO (M)	DESCRIPTION
0	10.70	Limestone, fine grained, crystalline, compact, hard along with calcite veinlets, fossils are also observed, fractures are filled with marly material, lenticular spotty white calcite is also observed in core recovery.
10.70	18.00	Limestone, fine grained, crystalline, highly fractured and jointed, fossils are observed calcite vugs are observed. Fractures are filled with brownish color marly material.
18.00	22.80	Limestone, fine grained, compact, fractured and jointed, fractures are filled with brownish color marly material. At the depth of 20.65 m to 20.80m the limestone is sandy. Thin lenticular veinlets of calcite are also observed.
22.80	28.96	Limestone, fine grained, compact, crystalline, jointed and fractured, fractures are filled with brownish color marly material. At a depth of 28.02 limestone is grey in color, sandy and medium bedded.
28.96	34.54	Limestone, highly jointed fractured, compact, fine grained, crystalline, fractured are filled with marly material brownish in color.
34.54	40.77	Limestone, fine to medium grained, fractured and jointed with thin veinlets of calcite. Fractures are filled with marly material brownish in color.
40.77	45.23	Limestone, fine grained, jointed, fractured, fractures are filled with brownish color marly material. Thin veinlets are lenticular and translucent.
45.23	50.00	Limestone, fine grained, crystalline, jointed, fractured, fractures are filled with marly material thin veinlets of calcite observed fossils in few core recoveries.

SARHAD DEVELOPMENT AUTHORITY



SURVEY AND EXPLORATION OF LIMESTONE AND CLAY DEPOSITS IN N.W.F.P



S. No.	Sample No.	CaO	MgO	SiO ₂	Fe ₂ O ₃	SO ₃	Na ₂ O	K ₂ O	SP. G.	W.T.	W.T.
01	LN-2-1	52.04	0.55	0.89	0.06	2.66	0.04	0.070	0.24	0.25	43.03
02	LN-2-2	51.84	0.49	0.87	0.07	2.32	0.05	0.030	0.23	0.26	41.92
03	LN-2-3	50.60	0.87	0.88	0.11	2.43	0.05	0.020	0.26	0.29	41.98
04	LN-2-4	50.28	0.74	0.67	0.08	1.98	0.05	0.020	0.19	0.28	44.41
05	LN-2-5	52.76	0.59	0.69	0.06	1.58	0.04	0.000	0.20	0.24	43.18
06	LN-2-6	51.66	0.68	0.84	0.04	1.12	0.06	0.040	0.22	0.23	43.34
07	LN-2-7	54.86	0.49	0.79	0.05	1.90	0.08	0.040	0.19	0.27	43.26
08	LN-2-8	50.77	0.58	0.80	0.04	1.88	0.04	0.000	0.20	0.26	44.48
09	LN-2-9	48.80	0.49	0.91	0.05	1.28	0.04	0.000	0.22	0.23	44.57
10	LN-2-10	49.85	0.98	0.90	0.08	1.94	0.04	0.000	0.20	0.24	44.20
11	LN-2-11	50.17	0.66	0.67	0.07	1.94	0.06	0.000	0.25	0.21	43.77
12	LN-2-12	48.16	0.49	0.25	0.04	4.43	0.04	0.000	0.28	0.26	44.30
13	LN-2-13	51.55	0.82	0.69	0.05	2.20	0.04	0.000	0.29	0.29	43.32
14	LN-2-14	49.04	0.58	0.82	0.08	4.06	0.04	0.000	0.27	0.30	43.57
15	LN-2-15	51.44	0.49	0.81	0.11	2.52	0.04	0.000	0.25	0.28	43.29
16	LN-2-16	49.71	0.54	0.88	0.07	2.88	0.04	0.010	0.26	0.31	43.76
17	LN-2-17	50.40	0.54	0.87	0.14	2.22	0.04	0.000	0.28	0.29	43.64
18	LN-2-18	53.00	0.56	0.82	0.11	0.67	0.04	0.000	0.29	0.27	43.37
Average Values		50.64	0.61	0.8	0.07	2.28	0.04	0.01	0.24	0.28	43.52

GEO LOG OF CORE DRILL HOLE NO-2 AND ITS CHEMICAL ANALYSIS NIZAMPUR AREA DISTT NOWSHERA

SARHAD DEVELOPMENT AUTHORITY
CORE DRILLING IN LIMESTONE
DEPOSITS AT DARU KHULA AREA
NIZAMPUR

PROJECT: SURVEY AND EXPLORATION
 OF LIMESTONE AND CLAY
 DEPOSITS FOR BASING
 CEMENT PLANTS IN NWFP.

HOLE NO. LN - 3

CORE SIZE - NX

TOTAL BORE DEPTH

50 M

CORE RECOVERY

45.00 M

PERCENTAGE OF CORE
 RECOVERY

90.00 %

DATE: March, 1996

LOGGED BY:

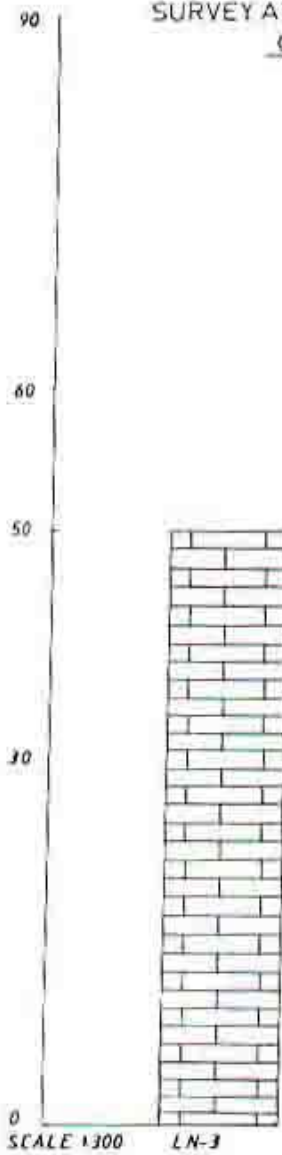
SELC PROJECT, SDA:-

FROM (M)	TO (M)	DESCRIPTION
01.00	10.23	Limestone, fine grained, compact, medium bedded, highly fractured and jointed at surface fractures and joints are filled with weathered brownish color material. Limestone is argillaceous crystalline with spotted calcite, veinlets. These veinlets are lenticular.
10.23	21.07	limestone, fine grained, compact, crystalline hard, joints are filled with brownish colored marly material. Calcite are filled in minor vugs and also lenticular veinlets. calcite is whitish in colour and translucent.
21.07	27.32	Limestone is grey in colour, fine grained highly fractured and jointed and crystalline. Few calcite veinlets observed, joints and fractures are filled with brownish colored material with translucent calcite veinlets.
27.32	40.00	Limestone, compact, crystalline, fine to medium grained, translucent lenticular veinlets observed in few core recovery. Some micro fossils are also observed.
40.00	50.00	Limestone, fine grained, medium bedded, hard crystalline, jointed & fractured. Joints are filled with brownish colored marly material. At a depth of 46.77 to 48.24 Limestone is siliceous, fossiliferous and highly fractured & jointed having whitish colour.

SARHAD DEVELOPMENT AUTHORITY



SURVEY AND EXPLORATION OF LIMESTONE AND CLAY DEPOSITS IN N.W.F.P



S ₁ No	Sample No	CaO %	MgO %	Al ₂ O ₃ %	Fe ₂ O ₃ %	SiO ₂ %	Na ₂ O %	K ₂ O %	SO ₃ %	Cl %	L.O.I %
1	LN3-01	52.84	0.82	0.61	0.05	2.28	0.06	0.020	0.30	0.27	42.48
2	LN3-02	52.86	0.66	0.59	0.05	2.08	0.04	0.020	0.28	0.28	42.43
3	LN3-03	51.96	0.64	0.56	0.07	2.58	0.11	0.010	0.26	0.30	42.81
4	LN3-04	52.48	0.56	0.49	0.04	2.00	0.07	0.020	0.25	0.24	43.26
5	LN3-05	52.86	0.51	0.52	0.04	2.36	0.07	0.030	0.27	0.23	42.88
6	LN3-06	52.84	0.66	0.50	0.05	2.70	0.08	0.020	0.28	0.22	42.32
7	LN3-07	52.64	0.58	0.51	0.05	2.96	0.09	0.010	0.24	0.23	42.09
8	LN3-08	53.76	0.54	0.48	0.05	2.42	0.06	0.010	0.40	0.25	41.61
9	LN3-09	53.08	0.49	0.48	0.01	2.66	0.06	0.010	0.38	0.24	41.98
10	LN3-10	54.42	0.51	0.47	0.04	1.50	0.07	0.010	0.32	0.24	41.92
11	LN3-11	53.76	0.54	0.48	0.03	1.88	0.07	0.010	0.31	0.27	42.44
12	LN3-12	53.42	0.51	0.47	0.04	1.56	0.07	0.010	0.29	0.26	42.81
13	LN3-13	54.65	0.51	0.46	0.03	1.61	0.07	0.020	0.41	0.20	41.69
14	LN3-14	53.08	0.63	0.48	0.03	2.18	0.08	0.010	0.37	0.29	42.11
15	LN3-15	53.65	0.66	0.47	0.06	2.30	0.09	0.010	0.36	0.27	41.53
16	LN3-16	49.28	0.63	0.72	0.05	5.36	0.09	0.010	0.32	0.38	42.73
17	LN3-17	53.76	0.56	0.49	0.06	2.40	0.09	0.020	0.31	0.25	41.83
18	LN3-18	54.65	1.02	0.45	0.06	1.60	0.08	0.020	0.30	0.24	41.30
Average values		53.08	0.74	0.51	0.04	2.33	0.07	0.01	0.31	0.25	42.12

GEO LOG OF CORE DRILL HOLE NO-3 AND ITS CHEMICAL ANALYSIS NIZAMPUR AREA DISTT NOWSHERA

SARHAD DEVELOPMENT AUTHORITY
CORE DRILLING IN LIMESTONE
DEPOSITS AT DARU KHULA AREA
NIZAMPUR

PROJECT: SURVEY AND EXPLORATION
 OF LIMESTONE AND CLAY
 DEPOSITS FOR BASING
 CEMENT PLANTS IN NWFP.

HOLE NO. LN - 4

CORE SIZE - NX

TOTAL BORE DEPTH

50 M

CORE RECOVERY

39.58 M

PERCENTAGE OF CORE
 RECOVERY

79.16 %

DATE: March, 1996

LOGGED BY:

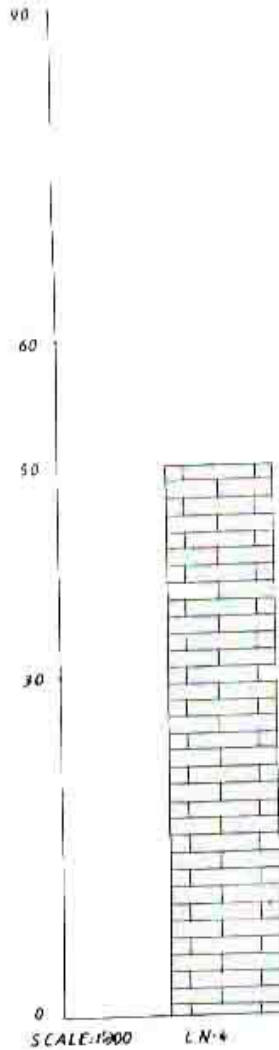
SELC PROJECT, SDA:-

FROM (M)	TO (M)	DESCRIPTION
01.00	5.88	Limestone, fine grained, hard, compact, yellowish color marly material filled in with fractures and joints. Lenticular calcite veinlets are visible. Calcite is translucent. Limestone is argillaceous and medium bedded. Fossils are also observed in few core recoveries.
5.88	9.62	Limestone, fine grained jointed & fractured. Lenticular calcite veinlets are decreases in depth. Limestone is argillaceous and fossiliferous. Medium bedded with lenses of sandy limestone.
9.62	15.53	Limestone, grey in color, fine grained, compact, crystalline, transparent calcite crystals observed. Lenticular veinlets of translucent calcite are also observed. Calcite deposited in fractures and vugs. Fossils in few core recoveries observed.
15.53	24.36	Limestone, fine grained, compact, argillaceous, medium bedded, fossils along with calcite veinlets, during drilling many cavities observed filled with transparent calcite crystals. Sandy limestone lenses are also observed in core recoveries.
24.36	34.67	Limestone, gray in color, fine grained, highly jointed and fractured along with sandy limestone lenses. Vugs are also observed during core drilling and recovered calcite crystals, fossils are also observed.
34.67	41.00	Limestone, gray in color, fine grained, fossiliferous highly jointed and fractured along with lenticular translucent veinlets of calcite. Limestone is argillaceous with lenses of sandy limestone. Some joints and fractures are filled in with marly material.
41.00	50.00	Limestone, fine grained, hard, compact, argillaceous along with calcite veinlets, and calcite crystals in cavities. Fossils are also observed in core recoveries. Sandy limestone lenses also observed in core.

SARHAD DEVELOPMENT AUTHORITY



SURVEY AND EXPLORATION OF LIMESTONE AND CLAY DEPOSITS IN N.W.F.P.



S. No	Sample No.	CaO %	MgO %	Al ₂ O ₃ %	Fe ₂ O ₃ %	SiO ₂ %	Na ₂ O %	K ₂ O %	SO ₃ %	LOI %	I. O. I %
01	LN-4-1	53.24	0.65	0.47	0.08	1.98	0.09	0.00	0.27	0.22	42.67
02	LN-4-2	52.89	0.61	0.40	0.07	1.90	0.07	0.00	0.25	0.23	42.54
03	LN-4-3	53.00	0.66	0.39	0.11	2.00	0.09	0.00	0.21	0.20	42.62
04	LN-4-4	52.22	0.82	0.37	0.03	1.44	0.08	0.00	0.20	0.18	42.45
05	LN-4-5	53.12	0.67	0.45	0.09	1.50	0.08	0.00	0.18	0.23	42.85
06	LN-4-6	52.94	0.44	0.50	0.07	1.52	0.09	0.00	0.15	0.24	42.99
07	LN-4-7	52.44	0.49	0.54	0.07	1.50	0.07	0.00	0.26	0.26	42.68
08	LN-4-8	52.28	0.49	0.62	0.04	2.46	0.07	0.00	0.17	0.25	42.47
09	LN-4-9	53.12	0.53	0.41	0.04	2.58	0.08	0.00	0.18	0.21	42.85
10	LN-4-10	52.08	0.50	0.58	0.03	1.94	0.08	0.00	0.26	0.19	42.76
11	LN-4-11	52.56	0.48	0.40	0.04	2.66	0.07	0.00	0.21	0.19	42.68
12	LN-4-12	53.24	0.53	0.43	0.06	0.20	0.08	0.00	0.22	0.21	42.91
13	LN-4-13	52.24	0.56	0.52	0.04	1.30	0.08	0.00	0.18	0.22	42.85
14	LN-4-14	53.24	0.61	0.56	0.13	1.50	0.08	0.00	0.16	0.26	42.55
15	LN-4-15	52.88	0.55	0.64	0.09	1.00	0.09	0.00	0.18	0.19	42.82
16	LN-4-16	53.36	0.51	0.44	0.20	0.96	0.06	0.00	0.17	0.22	42.13
	Average Values	52.17	0.56	0.48	0.06	1.52	0.08	0.00	0.19	0.22	42.83

GEO LOG OF CORE DRILL HOLE NO-4 AND ITS CHEMICAL ANALYSIS NIZAMPUR AREA DIST. NOWSHERA

SARHAD DEVELOPMENT AUTHORITY
CORE DRILLING IN LIMESTONE
DEPOSITS AT DARU KHULA AREA
NIZAMPUR

PROJECT: SURVEY AND EXPLORATION
 OF LIMESTONE AND CLAY
 DEPOSITS FOR BASING
 CEMENT PLANTS IN NWFP.

HOLE NO. LN - 5

CORE SIZE - NX

TOTAL BORE DEPTH

50 M

CORE RECOVERY

38.00 M

PERCENTAGE OF CORE
 RECOVERY

76.00 %

DATE: APRIL, 1956

LOGGED BY:

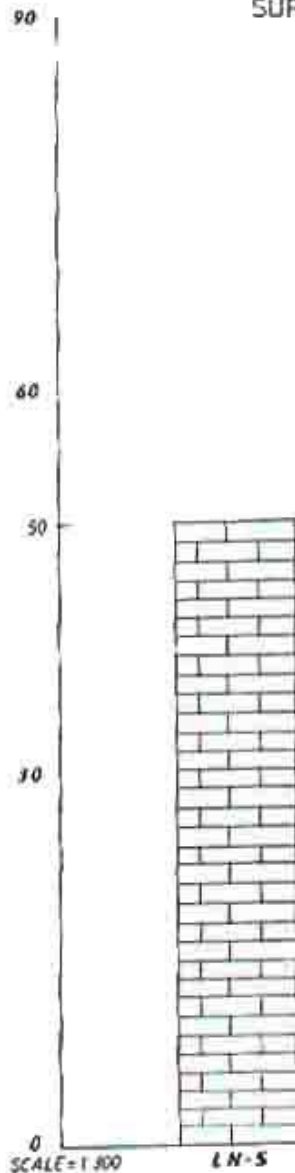
SELC PROJECT, SDA

FROM (M)	TO (M)	DESCRIPTION
0.00	11.70	Limestone is fine grained, compact, hard, medium to thick bedded, jointed and fractured. Fractures are filled with earthy material. The calcite veinlets are present throughout the core drilling. Calcite veins are lenticular and translucent.
11.70	25.11	Limestone is compact, hard, fine grained, medium to thick bedded; the calcite veinlets are lenticular, translucent and increasing in quantity in depth. Fossils are also observed in core at different places. At depth of 25 m the limestone was argillaceous.
25.11	25.43	Limestone is fine grained, highly fractured and jointed fractures are filled with brownish colored earthy material. Lenticular veinlets of calcite are in abundance and translucent.
31.81	50.00	Limestone is fine grained, compact, hard, crystalline gray in color. Medium to thick bedded. Translucent calcite veinlets in lenticular structure are also observed. Fractures are filled with earthy clayey material. Calcite crystals in veins are also observed.

SARHAD DEVELOPMENT AUTHORITY



SURVEY AND EXPLORATION OF LIMESTONE AND CLAY DEPOSITS IN N.W.F.P



S. No	Sample No	CaO %	MgO %	Al ₂ O ₃ %	Fe ₂ O ₃ %	SiO ₂ %	Na ₂ O %	K ₂ O %	SO ₃ %	Cl %	L.O.I %
01	LNS-1	52.64	0.49	0.140	0.18	2.64	0.08	0.020	0.27	0.28	42.08
02	LNS-2	50.62	0.76	0.650	0.29	4.66	0.09	0.030	0.17	0.31	42.00
03	LNS-3	52.41	0.49	0.570	0.25	2.24	0.08	0.010	0.22	0.28	42.93
04	LNS-4	52.64	0.49	0.090	0.25	2.76	0.10	0.020	0.20	0.31	42.86
05	LNS-5	52.86	0.99	0.690	0.18	1.88	0.09	0.020	0.15	0.31	42.03
06	LNS-6	50.72	1.49	0.420	0.18	2.49	0.08	0.020	0.28	0.28	43.33
07	LNS-7	50.62	1.09	0.370	0.29	2.62	0.10	0.040	0.14	0.24	43.28
08	LNS-8	52.19	0.58	0.310	0.18	2.16	0.08	0.020	0.16	0.31	43.21
09	LNS-9	51.74	0.69	0.790	0.25	2.70	0.09	0.020	0.17	0.31	42.30
10	LNS-10	49.60	0.58	0.009	0.18	4.76	0.08	0.010	0.28	0.28	42.50
11	LNS-11	49.05	1.32	0.790	0.14	7.36	0.08	0.020	0.18	0.28	40.55
12	LNS-12	48.14	1.65	0.690	0.18	5.22	0.10	0.020	0.29	0.31	41.84
13	LNS-13	48.04	0.99	0.660	0.18	3.18	0.06	0.100	0.27	0.24	40.12
14	LNS-14	49.38	0.32	0.420	0.18	5.14	0.09	0.030	0.28	0.28	42.06
15	LNS-15	50.17	0.66	0.500	0.18	4.10	0.09	0.040	0.19	0.28	42.10
16	LNS-16	49.38	0.66	0.280	0.18	3.68	0.08	0.040	0.29	0.31	42.90
	Average Values	50.63	0.81	0.46	0.20	3.61	0.08	0.42	0.20	0.28	42.25

GEO LOG OF CORE DRILL HOLE NO-5 AND ITS CHEMICAL ANALYSIS NIZAMPUR AREA DIST: NOWSHERA

SARHAI DEVELOPMENT AUTHORITY
CORE DRILLING IN LIMESTONE
DEPOSITS AT DARU KHULA AREA
NIZAMPUR

PROJECT: SURVEY AND EXPLORATION
 OF LIMESTONE AND CLAY
 DEPOSITS FOR BASING
 CEMENT PLANTS IN NWFP.

HOLE NO. LN - 6

CORE SIZE - NX

TOTAL BORE DEPTH

75 M

CORE RECOVERY

56.74 M

PERCENTAGE OF CORE
 RECOVERY

75.15 %

DATE: APRIL, 1996

LOGGED BY:

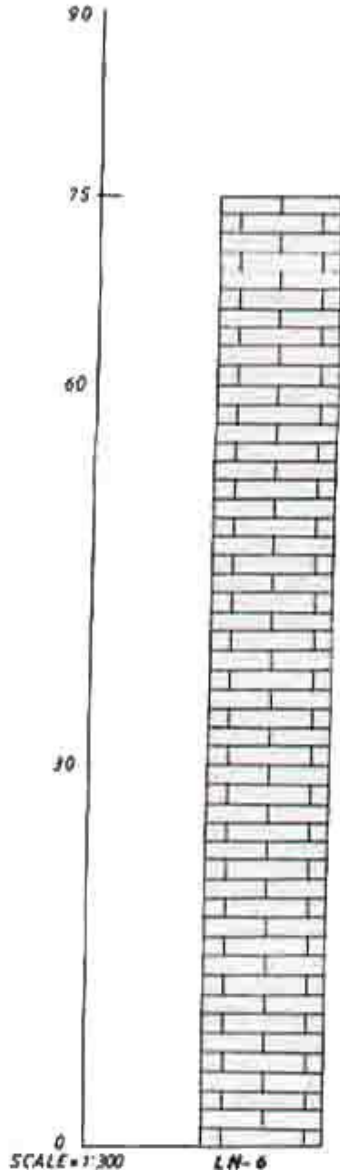
SELC PROJECT, SDA:-

FROM (M)	TO (M)	DESCRIPTION
0.00	20.96	Limestone is fine grained, crystalline compact, medium bedded upto 3 m depth limestone is highly fractured and jointed. Fractures are filled with brownish colored marly material. Lenticular veinlets of calcite are also present. At a depth of 4.8 m thick bedded argillaceous limestone is encountered.
20.96	43.11	Limestone is fine grained, compact, highly fractured and jointed at places fractures are filled with marly material. Fossils and lenticular veinlets of calcite are also observed.
43.11	62.85	Limestone is fine grained, highly fractured and jointed. Joints and fractures are filled in with brownish colored marly material with minute lenticular translucent calcite veinlets, fossils are also observed under hand lens. At a depth of 43.11m

SARHAD DEVELOPMENT AUTHORITY



SURVEY AND EXPLORATION OF LIMESTONE AND CLAY DEPOSITS IN N.W.F.P



S. No.	Sample No.	CaO %	MgO %	Al ₂ O ₃ %	Fe ₂ O ₃ %	SiO ₂ %	Na ₂ O %	K ₂ O %	SO ₃ %	Cl %	L.O.I %
01	LN6-1	54.88	0.58	0.28	0.29	0.96	0.45	0.020	0.25	0.20	41.35
02	LN6-2	51.52	1.32	0.02	0.29	3.04	0.44	0.060	0.21	0.26	41.49
03	LN6-3	54.65	0.82	0.03	0.29	1.62	0.48	0.030	0.22	0.23	41.51
04	LN6-4	52.41	0.82	0.04	0.14	3.26	0.44	0.040	0.18	0.20	41.95
05	LN6-5	52.41	0.82	0.06	0.14	1.60	0.48	0.030	0.21	0.22	42.69
06	LN6-6	51.52	1.49	0.52	0.18	2.40	0.47	0.060	0.20	0.19	42.09
07	LN6-7	51.84	0.66	0.23	0.18	1.72	0.48	0.020	0.14	0.21	43.03
08	LN6-8	51.95	0.66	0.08	0.18	2.56	0.43	0.020	0.12	0.20	43.09
09	LN6-9	51.40	0.82	0.42	0.29	2.30	0.48	0.020	0.18	0.17	42.88
10	LN6-10	51.40	0.66	0.09	0.18	2.18	0.51	0.020	0.22	0.19	42.46
11	LN6-11	52.29	0.66	0.08	0.10	2.46	0.47	0.020	0.20	0.16	42.17
12	LN6-12	52.96	0.82	0.06	0.07	1.30	0.48	0.020	0.21	0.21	42.32
13	LN6-13	52.96	0.82	0.07	0.10	0.88	0.49	0.020	0.16	0.16	42.53
14	LN6-14	51.17	0.66	0.14	0.20	3.48	0.51	0.020	0.18	0.15	42.25
15	LN6-15	53.19	0.66	0.23	0.07	1.30	0.49	0.030	0.17	0.18	42.42
16	LN6-16	52.24	0.82	0.09	0.10	2.30	0.47	0.020	0.14	0.22	41.80
17	LN6-17	52.50	0.66	0.42	0.14	2.88	0.49	0.040	0.15	0.23	42.14
18	LN6-18	52.52	0.66	0.65	0.07	0.82	0.49	0.020	0.18	0.20	42.93
19	LN6-19	50.12	1.32	0.56	0.14	2.40	0.44	0.030	0.13	0.17	42.93
20	LN6-20	51.41	0.66	1.03	0.07	2.90	0.48	0.020	0.12	0.14	42.62
21	LN6-21	50.82	1.49	0.56	0.10	2.98	0.52	0.040	0.11	0.18	42.92
22	LN6-22	51.17	0.74	0.14	0.03	2.98	0.47	0.030	0.16	0.19	43.04
23	LN6-23	51.16	0.66	0.08	0.07	2.78	0.51	0.030	0.13	0.17	43.49
24	LN6-24	50.84	0.66	0.28	0.07	3.26	0.49	0.030	0.12	0.16	42.59
Average Values		52.07	0.82	0.25	0.14	2.26	0.47	0.02	0.16	0.19	42.44

GEO LOG OF CORE DRILL HOLE NO-6 AND ITS CHEMICAL ANALYSIS NIZAMPUR AREA DISTT NOWSHERA

SARHAD DEVELOPMENT AUTHORITY
CORE DRILLING IN LIMESTONE
DEPOSITS AT DARU KHULA AREA
NIZAMPUR

PROJECT: SURVEY AND EXPLORATION
 OF LIMESTONE AND CLAY
 DEPOSITS FOR BASING
 CEMENT PLANTS IN NWFP.

HOLE NO. LN - 7

CORE SIZE - NX

TOTAL BORE DEPTH

75 M

CORE RECOVERY

58.56 M

PERCENTAGE OF CORE
 RECOVERY

77.77 %

DATE: MAY, 1996

LOGGED BY:

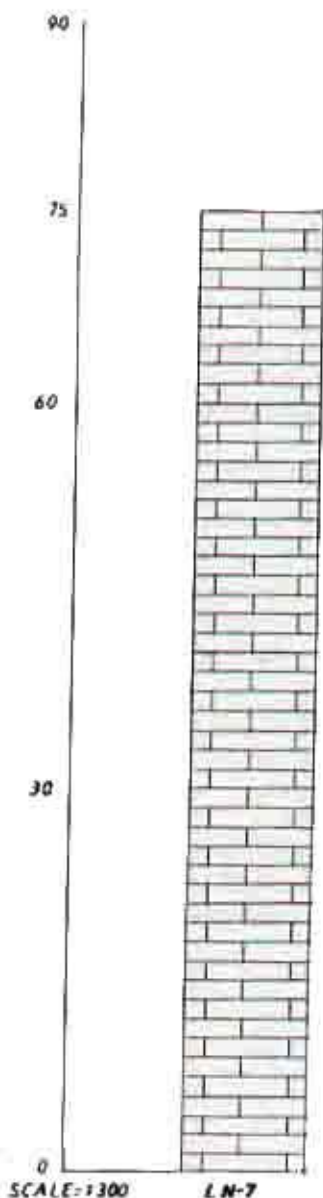
SELC PROJECT, SDA

FROM (M)	TO (M)	DESCRIPTION
0.00	13.32	Limestone is fine grained, crystalline, medium bedded, compact, hard, spotted lenticular veinlets of calcite are observed, minor fractures are filled with marly material of brownish color. Fossils and translucent calcite crystals are also observed.
13.32	24.07	Limestone is fine grained highly fractured and jointed, fractures are filled with marly material. Micro fossils are also observed under hand lens. Lenticular veinlets are also observed in abundance at places. Some vugs are observed which are filled with translucent calcite material.
24.07	29.82	Limestone fine grained, compact, hard, medium bedded, crystalline. Minute calcite lenticular veinlets are also observed. At a depth of 28.56 m to 29.82m Limestone is siliceous and highly fossiliferous.
29.82	38.83	Limestone, fine grained, compact, medium to thick bedded. Jointed and fractured along with translucent lenticular veinlets, spotted fossils are also observed.
38.83	53.41	Limestone is fine grained, crystalline, highly fractured and jointed. Fractures and joints are filled with brownish colored marly material. Calcite veinlets and calcite crystals in vugs are also observed.
53.41	70.81	Limestone is fine grained, crystalline, highly fractured and jointed. Fractures and joints are filled with brownish colored marly material. Calcite veinlets and calcite crystals in vugs and spotted fossils are also observed.
70.81	75.29	Limestone is fine grained compact, hard, crystalline, minute translucent lenticular veinlets of calcite are observed, fractures and joints at places are filled with brownish colored marly material. Fossils are also observed at some places.

SARHAD DEVELOPMENT AUTHORITY



SURVEY AND EXPLORATION OF LIMESTONE AND CLAY DEPOSITS IN NWFP



S. No	Sample No	CaO	MgO	Al ₂ O ₃	Fe ₂ O ₃	SiO ₂	Na ₂ O	K ₂ O	SO ₂	LOI	LOI
01	LN7-1	51.52	0.66	0.003	0.73	4.06	0.44	0.07	0.18	0.13	41.50
02	LN7-2	53.76	0.82	0.140	0.36	1.42	0.45	0.03	0.10	0.09	41.20
03	LN7-3	53.50	0.66	0.140	0.36	2.14	0.40	0.02	0.11	0.10	41.88
04	LN7-4	53.98	0.55	0.420	0.29	1.56	0.45	0.02	0.13	0.11	41.98
05	LN7-5	52.64	0.66	0.020	0.29	3.22	0.40	0.03	0.12	0.12	41.55
06	LN7-6	52.64	0.82	0.280	0.36	3.26	0.45	0.03	0.12	0.11	41.74
07	LN7-7	50.84	0.82	0.090	0.36	5.24	0.41	0.02	0.10	0.11	40.70
08	LN7-8	51.96	0.77	0.370	0.69	3.46	0.43	0.02	0.15	0.12	40.71
09	LN7-9	53.98	0.74	0.110	0.36	1.32	0.47	0.02	0.13	0.09	41.52
10	LN7-10	53.98	0.82	0.280	0.18	1.02	0.40	0.04	0.13	0.08	41.83
11	LN7-11	53.08	0.82	0.140	0.35	2.42	0.43	0.02	0.12	0.09	40.62
12	LN7-12	51.74	0.71	0.200	0.21	3.66	0.39	0.02	0.10	0.14	40.82
13	LN7-13	52.64	0.74	0.140	0.29	4.38	0.45	0.04	0.12	0.11	40.44
14	LN7-14	51.52	0.79	0.480	0.10	3.40	0.40	0.04	0.10	0.14	41.06
15	LN7-15	52.19	0.82	0.009	0.32	4.12	0.39	0.02	0.14	0.12	39.96
16	LN7-16	52.85	1.16	0.280	0.18	2.42	0.42	0.02	0.13	0.11	40.87
17	LN7-17	50.34	0.77	0.009	0.36	5.68	0.51	0.03	0.15	0.14	40.02
18	LN7-18	53.78	0.82	0.280	0.36	1.64	0.43	0.02	0.10	0.10	42.12
19	LN7-19	53.38	0.82	0.004	0.29	1.10	0.41	0.02	0.09	0.09	42.02
20	LN7-20	51.52	0.66	0.280	0.29	2.44	0.38	0.03	0.15	0.12	42.34
21	LN7-21	52.36	0.74	0.004	0.10	1.62	0.40	0.02	0.12	0.10	42.23
22	LN7-22	53.31	0.82	0.420	0.10	1.00	0.38	0.02	0.10	0.10	42.75
23	LN7-23	51.96	0.91	0.140	0.36	3.50	0.49	0.04	0.14	0.13	41.53
24	LN7-24	52.19	0.66	0.003	0.25	2.04	0.43	0.02	0.11	0.12	42.82
Average Values		52.56	0.77	0.17	0.31	2.74	0.44	0.02	0.13	0.11	39.88

GEO LOG OF CORE DRILL HOLE NO-7 AND ITS CHEMICAL ANALYSIS NIZAMPUR AREA DISTT NOWSHERA

SARHAD DEVELOPMENT AUTHORITY
CORE DRILLING IN LIMESTONE
DEPOSITS AT DARU KHULA AREA
NIZAMPUR

PROJECT: SURVEY AND EXPLORATION
 OF LIMESTONE AND CLAY
 DEPOSITS FOR BASING
 CEMENT PLANTS IN NWFP.

HOLE NO. LN - 8

CORE SIZE - NX

TOTAL BORE DEPTH

79 M

CORE RECOVERY

62.00 M

PERCENTAGE OF CORE
 RECOVERY

78.48 %

DATE: JAN 1996

LOGGED BY:

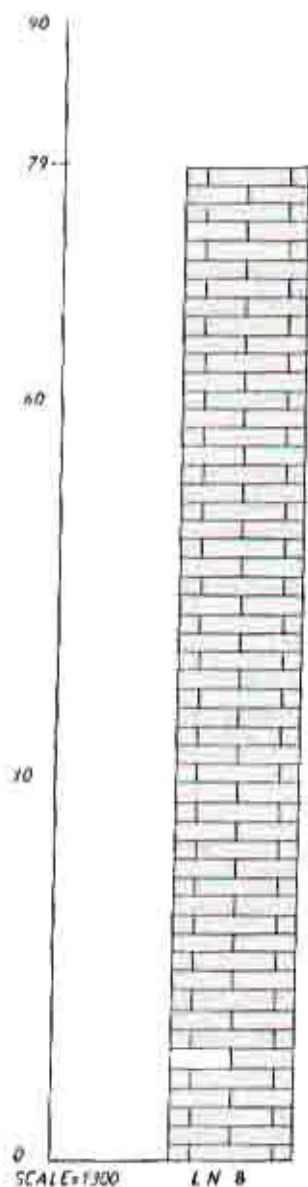
SELC PROJECT, SDA

FROM (M)	TO (M)	DESCRIPTION
0.00	11.39	Limestone is light gray to gray in color of Lockhart formation. Fine grained, compact, crystalline, nodular at places, abundant lenticular calcite veinlets along with fractures and joints are observed. Vugs are filled with opaque color calcite cubic crystals. At places iron staining and fossils are also observed.
11.39	22.87	Limestone is fine grained, compact, hard and argillaceous. Jointed and fractured along with calcite veinlets, medium bedded. During drilling vugs and fractures are observed which were filled in with gravel and marly material.
22.87	40.38	Limestone is fine grained, hard, crystalline, medium bedded, light grey to gray in color. Lenticular veinlets of calcite are observed. Spotted fossils and pyrite crystals. Water solution vugs and cavities are also observed.
40.38	50.05	Limestone fine grained, compact, hard lenticular opaque calcite veinlets, medium bedded, fractured and jointed. At a depth of 50 m to 51.50m rocks are highly fractured.
50.05	68.66	Limestone, grey in color, fine grained, argillaceous, compact, hard, crystalline medium bedded. Opaque calcite veinlets are highly jointed, fractures and joints are filled in with marly material.
68.66	79.00	Light grey to gray in color, fine grained limestone of Lockhart formation. Compact hard, argillaceous lenticular, calcite veinlets, pyrite crystals and fossils are also observed.

SARHAD DEVELOPMENT AUTHORITY



SURVEY AND EXPLORATION OF LIMESTONE AND CLAY DEPOSITS IN N.W.F.P.



S. No.	Sample No.	CaO %	MgO %	Al ₂ O ₃ %	Fe ₂ O ₃ %	SiO ₂ %	Na ₂ O %	K ₂ O %	SO ₂ %	C %	I.P.I.
01	LNB-01	52.47	0.82	0.28	0.14	2.08	0.43	0.06	0.26	0.29	41.93
02	LNB-02	51.52	1.16	0.22	0.18	2.60	0.45	0.05	0.25	0.27	41.77
03	LNB-03	50.40	1.32	0.28	0.29	2.64	0.47	0.03	0.27	0.24	42.24
04	LNB-04	52.64	1.16	0.35	0.14	1.72	0.44	0.06	0.22	0.19	42.08
05	LNB-05	50.40	0.99	0.35	0.07	3.08	0.43	0.03	0.28	0.20	41.67
06	LNB-06	52.64	0.80	0.28	0.07	2.54	0.43	0.04	0.24	0.22	42.00
07	LNB-07	51.96	1.16	0.42	0.06	1.28	0.41	0.03	0.27	0.21	42.92
08	LNB-08	53.76	0.66	0.22	0.10	0.82	0.47	0.02	0.26	0.23	42.41
09	LNB-09	52.64	0.66	0.28	0.07	2.44	0.41	0.03	0.24	0.20	41.94
10	LNB-10	53.08	0.82	0.20	0.07	1.60	0.44	0.02	0.19	0.22	42.59
11	LNB-11	52.47	0.99	0.35	0.08	1.54	0.44	0.02	0.25	0.19	42.22
12	LNB-12	52.19	0.82	0.34	0.08	1.74	0.43	0.01	0.24	0.21	42.35
13	LNB-13	52.47	0.99	0.42	0.06	1.32	0.48	0.01	0.22	0.18	42.05
14	LNB-14	50.96	1.32	0.28	0.10	2.22	0.47	0.01	0.21	0.16	42.24
15	LNB-15	45.80	2.98	0.42	0.07	2.86	0.45	0.04	0.20	0.14	40.64
16	LNB-16	46.02	2.48	0.14	0.06	8.14	0.44	0.04	0.22	0.16	40.36
17	LNB-17	51.29	1.16	0.42	0.06	4.16	0.43	0.03	0.23	0.15	41.84
18	LNB-18	50.60	0.82	0.35	0.07	3.62	0.47	0.03	0.21	0.18	41.81
19	LNB-19	51.29	0.99	0.35	0.03	4.32	0.45	0.03	0.20	0.19	41.33
20	LNB-20	51.24	1.32	0.42	0.03	3.32	0.43	0.03	0.21	0.17	41.63
21	LNB-21	49.92	1.32	0.28	0.05	3.58	0.45	0.03	0.24	0.16	42.22
22	LNB-22	51.96	1.49	0.42	0.03	2.12	0.51	0.02	0.23	0.14	42.46
23	LNB-23	51.52	0.82	0.42	0.03	2.40	0.48	0.02	0.21	0.18	41.32
24	LNB-24	51.62	0.66	0.28	0.03	2.62	0.44	0.02	0.19	0.22	42.79
25	LNB-25	50.48	0.82	0.42	0.03	3.36	0.44	0.02	0.17	0.23	42.13
26	LNB-26	52.86	0.74	0.14	0.06	1.56	0.56	0.02	0.18	0.22	42.61
	Average Values	51.30	1.12	0.31	0.07	2.89	0.45	0.03	0.22	0.19	41.97

GEO LOG OF CORE DRILL HOLE NO-8 AND ITS CHEMICAL ANALYSIS NIZAMPUR AREA DISTT NOWSHERA

1.8 RESERVES OF THE LIMESTONE DEPOSITS AT DARU KHULA AREA NIZAMPUR DISTRICT NOWSHERA

The Limestone deposits at Daru Khula area Nizampur are exposed on the surface. The inferred Reserves of these deposits were calculated initially to a tune of 249 m.m which were enhanced later on to 490 m.m.t. including West ward extension of these deposits. The depth of the Limestone out crops was proved to 150 meters through core drilling and the reserves of these deposits were estimated to a tune of 210 m.m.tones in proved category with the following measurement.

Length of Limestone out crops	= 2500 m.
Average depth	= 150 m.
Average width	= 200 m.
Sp. Gravity	= 2.8 m.
Tonnage $2500 \times 150 \times 200 \times 2.8 =$	210 m.m.tones

1.9 CLAY DEPOSITS AT DARU KHULA AREA -NIZAM PUR

At the foot hills of Limestone deposits huge deposits of Clay near Marooba and Ghalib baba areas are present. Initially 4 No. clay samples were collected from these deposits and later on 10 No. samples were collected from these deposits. These samples were analyzed for CaO, MgO, SiO₂, SO₃, Fe₂O₃, Al₂O₃, K₂O, Na₂O, Cl and L.O.I. Chemical analysis results of these samples are favorable for Cement grade. The results are shown in the following table.

TABLE NO : 1.3

ANALYSIS RESULTS OF CLAY SAMPLES COLLECTED FROM THE CLAY DEPOSITS AT DARU KHULA AREA-NIZAMPUR

S.NO.	SAMPLE NO.	CaO	MgO	SiO ₂	Fe ₂ O ₃	Al ₂ O ₃	K ₂ O	Na ₂ O	Cl	SO ₃	L.O.I
:	:	%	%	%	%	%	%	%	%	%	%
1.	CL-9	11.00	1.15	59.00	3.70	11.08	1.59	0.98	0.14	0.18	10.69
2.	CL-10	9.10	1.99	59.1	3.00	12.21	2.00	0.95	0.15	0.17	10.90
3.	CL-11	10.12	1.82	60.10	3.43	11.74	2.12	0.97	0.16	0.15	9.00
4.	CL-12	6.23	0.33	68.98	0.50	12.12	0.72	0.26	0.15	0.16	10.03
5.	CLN-39	9.20	2.00	12.70	4.50	55.40	0.55	3.01	0.25	0.17	11.39
6.	CLN-40	7.50	1.50	12.50	4.71	60.00	0.53	2.89	0.25	0.18	9.20
7.	CLN-41	11.64	2.48	12.50	4.28	50.20	0.62	2.77	0.22	0.15	13.47
8.	CLN-42	14.56	2.48	10.80	4.14	49.60	0.64	2.89	0.23	0.14	13.23
9.	CLN-43	8.06	2.32	11.30	4.71	55.20	0.60	3.13	0.22	0.13	13.21
10.	CLN-44	13.44	2.48	11.30	4.00	51.20	0.47	2.40	0.26	0.12	12.92
11.	CLN-45	11.48	2.32	11.80	4.00	52.20	0.48	3.49	0.24	0.14	12.64
12.	CLN-46	12.50	2.32	11.90	3.86	53.40	0.48	2.65	0.21	0.13	12.00
13.	CLN-47	12.00	2.32	11.90	4.14	53.40	0.52	2.77	0.20	0.12	11.58
14.	CLN-48	11.42	2.32	11.60	3.89	53.40	0.52	2.77	0.19	0.11	12.29

Handwritten notes:
 clay sample
 At 25% from
 CLN-39 to 48
 not possible.

1.10 AUGER AND CORE DRILLING IN CLAY DEPOSITS AT DARU KHULA AREA- NIZAMPUR

To check the quality of clay deposits at Daru Khula area Nizampur at more depth 100 meters Auger and 150 meters Core drilling was carried out in the clay deposits at the foot hills and near Marooba village and Ghalib baba Ziarat Daru Khula area Nizampur.

25 Nos samples (AHN-28 to AHN-52) were collected through Auger drilling and 6 Nos samples (NCS-1 to NCS-6) were collected through Core drilling. These samples were analyzed for CaO, MgO, SiO₂, Fe₂O₃, Al₂O₃, K₂O, Na₂O, SO₃, Cl and L.O.I. The chemical analysis results are shown in the following table No 1.4.

Table No 1.4

ANALYSIS RESULTS OF CLAY SAMPLES COLLECTED FROM
THE CLAY DEPOSITS AT DARU KHULA AREA NIZAMPUR
THROUGH CORE AND AUGER DRILLING

S.NO.	SAMPLE NO	CaO	MgO	Al ₂ O ₃	Fe ₂ O ₃	SiO ₂	Na ₂ O	K ₂ O	SO ₃	Cl	L.O.I
1.	AHN- 28	12.58	1.32	11.90	4.71	47.00	2.02	3.49	0.45	0.41	15.10
2.	AHN- 29	8.98	1.98	12.30	3.28	53.20	1.61	3.25	0.62	0.47	14.02
3.	AHN- 30	14.11	1.49	11.30	4.71	46.60	2.02	2.89	0.54	0.40	14.78
4.	AHN- 31	18.40	1.26	9.90	4.00	40.00	1.61	2.16	0.49	0.37	20.52
5.	AHN- 32	20.64	1.16	11.10	3.57	35.20	1.34	1.92	0.47	0.32	23.15
6.	AHN- 33	14.28	1.65	11.50	3.43	46.00	2.02	2.65	0.52	0.35	16.89
7.	AHN- 34	12.80	1.49	11.40	3.71	48.20	1.88	2.52	0.40	0.37	16.27
8.	AHN- 35	8.18	2.65	12.80	3.14	59.60	2.42	3.37	0.39	0.41	6.42
9.	AHN- 36	9.58	2.48	12.10	3.00	54.40	2.69	3.61	0.37	0.49	10.47
10.	AHN- 37	7.18	2.48	12.30	3.86	61.60	1.88	3.13	0.28	0.55	6.39
11.	AHN- 38	10.39	2.48	12.30	4.00	54.20	2.02	3.13	0.25	0.47	9.72
12.	AHN- 39	9.79	2.48	12.30	4.00	56.80	1.88	2.89	0.31	0.45	8.22
13.	AHN- 40	7.79	2.81	12.50	4.00	59.00	2.02	3.25	0.39	0.48	6.78
14.	AHN- 41	10.18	2.65	13.30	4.57	55.20	2.29	3.13	0.36	0.50	6.66
15.	AHN- 42	8.99	2.15	12.70	4.71	58.00	2.15	3.25	0.40	0.52	6.60
16.	AHN- 43	9.58	2.65	12.60	4.71	52.20	1.88	3.01	0.44	0.31	11.31
17.	AHN- 44	6.18	2.81	12.60	4.14	60.80	2.02	3.25	0.47	0.35	6.68
18.	AHN- 45	9.39	2.65	13.50	4.29	55.00	2.15	3.25	0.55	0.30	8.18
19.	AHN- 46	9.18	2.32	13.00	4.71	56.60	1.61	2.89	0.54	0.28	8.37
20.	AHN- 47	7.79	2.65	12.10	4.71	59.20	1.75	3.25	0.50	0.25	7.03

S.NO.	SAMPLE NO	CaO %	MgO %	Al ₂ O ₃ %	Fe ₂ O ₃ %	SiO ₂ %	Na ₂ O %	K ₂ O %	SO ₃ %	Cl %	L.O.I %
21	AHN- 48	10.79	2.48	12.10	4.71	55.20	1.75	3.01	0.28	0.23	8.15
22	AHN- 49	8.79	2.32	12.40	4.28	58.20	1.75	3.25	0.24	0.22	7.26
23	AHN- 50	9.18	2.15	12.20	4.43	55.00	1.61	2.77	0.17	0.20	11.54
24	AHN- 51	7.79	2.81	12.60	4.28	60.80	1.75	2.89	0.14	0.17	6.18
25	AHN- 52	7.98	2.32	12.20	4.00	59.60	1.61	2.89	0.19	0.15	7.98
26	NCS- 1	12.59	1.82	11.30	-	57.40	0.25	1.08	0.27	0.21	13.04
27	NCS- 2	11.19	1.82	12.10	-	57.80	0.29	1.20	0.25	0.19	13.24
28	NCS- 3	11.19	1.98	11.70	-	57.60	0.29	1.20	0.28	0.17	12.58
29	NCS- 4	4.19	1.32	11.90	-	68.40	0.18	1.32	0.26	0.14	8.58
30	NCS- 5	5.59	1.49	12.40	-	67.20	0.21	1.44	0.25	0.16	8.61
31	NCS- 6	6.99	1.16	12.70	-	67.40	0.18	1.45	0.24	0.15	7.17

-(24) :-

SARHAD DEVELOPMENT AUTHORITY
CORE DRILLING IN CLAY DEPOSIT
AT DARU KHULA AREA NIZAMPUR

PROJECT: SURVEY AND EXPLORATIO
OF LIMESTONE AND CLAY
DEPOSITS FOR BASING
CEMENT PLANTS IN NWFP

HOLE NO. NC - 1

CORE SIZE - PX

TOTAL BORE DEPTH

20 M

CORE RECOVERY

20 M

PERCENTAGE OF CORE
RECOVERY

100 %

DATE: NOVEMBER, 96

LOGGED BY:

SELC PROJECT, SDA

FROM (M)	TO (M)	DESCRIPTION
0.00	12.00	Brownish colored silty Clay, fine grained loose upto 1.5 m. Compact in depth.
12.00	20.00	Clay- fine grained, compact, silica content on higher side. Lenses of Limestone pebbles upto 5 cm in size are present

SARHAD DEVELOPMENT AUTHORITY
CORE DRILLING IN CLAY DEPOSIT
AT DARU KHULA AREA, NIZAMPUR

PROJECT: SURVEY AND EXPLORATION
OF LIMESTONE AND CLAY
DEPOSITS FOR BASING
CEMENT PLANTS IN NWFP.

HOLE NO. NC - 2

CORE SIZE - PX

TOTAL BORE DEPTH

20 M

CORE RECOVERY

20 M

PERCENTAGE OF CORE
RECOVERY

100 %

DATE: NOVEMBER, 96

LOGGED BY:

SELC PROJECT, SDA

FORM (M)	TO (M)	DESCRIPTION
0.00	8.00	Clay - Yellowish to brownish in colour. Silty loose along with pebbles lenses.
8.00	15.00	Clay - Fine grained, compact along with pebbles lenses.
15.00	20.00	Clay - Fine grained, compact, soft, silty, highly soapy.

SARHAD DEVELOPMENT AUTHORITY
CORE DRILLING IN CLAY DEPOSITS
AT DARU KHULA AREA NIZAM PUR

PROJECT: SURVEY AND EXPLORATION OF LIMESTONE AND CLAY DEPOSITS FOR BASING CEMENT PLANTS IN NWFP.	HOLE NO. NC - 3
	CORE SIZE - PX

TOTAL BORE DEPTH 20 M	CORE RECOVERY 20 M	PERCENTAGE OF CORE RECOVERY 100 %
------------------------------	---------------------------	---

DATE: NOVEMBER, 96	LOGGED BY:	SELC PROJECT, SDA
--------------------	------------	-------------------

FORM (M)	TO (M)	DESCRIPTION
0.00	12.00	Brownish colored loose clay, fine grained silty along with pebbles of limestone lenses, about 5 cm - 10 cm.
12.00	20.00	Silty clay - fine grained, brownish colored, pebbles of Limestone lenses are present.

SARHAD DEVELOPMENT AUTHORITY
CORE DRILLING IN CLAY DEPOSITS
AT DARU KHULA AREA, NIZAMPUR

PROJECT: SURVEY AND EXPLORATION
OF LIMESTONE AND CLAY
DEPOSITS FOR BASING
CEMENT PLANTS IN NWFP.

HOLE NO. NC - 4

CORE SIZE - PX

TOTAL BORE DEPTH

20 M

CORE RECOVERY

20 M

PERCENTAGE OF CORE
RECOVERY
100 %

DATE: NOVEMBER, 96

LOGGED BY:

SELC PROJECT, SDA

FORM (M)	TO (M)	DESCRIPTION
0.00	17.00	Clay - Brownish colour, fine grained, compact, siliceous, along with lenses of Sand Stone and calcareous shale. Clay most probably belongs to patala formation.
17.00	20.00	Clay - Sandy clay 18.5m - 20 m observed, gravel are also present.

SARHAD DEVELOPMENT AUTHORITY
CORE DRILLING IN CLAY DEPOSITS
AT DARU KHULA AREA NIZAMPUR

PROJECT: SURVEY AND EXPLORATION
 OF LIMESTONE AND CLAY
 DEPOSITS FOR BASING
 CEMENT PLANTS IN NWFP.

HOLE NO. NC - 5

CORE SIZE - PX

TOTAL BORE DEPTH
 20 M

CORE RECOVERY
 20 M

PERCENTAGE OF CORE
 RECOVERY
 100 %

DATE: NOVEMBER, 96 LOGGED BY: SELC PROJECT, SDA

FORM (M)	TO (M)	DESCRIPTION
0.00	17.00	Shale - Brownish colored, compact, fine grained, along with sandstone and calcareous shale lenses. Patala Formation.
17.00	20.00	Clay - Sandy, loose along with lenses of sandstone.

SARHAD DEVELOPMENT AUTHORITY
CORE DRILLING IN CLAY DEPOAITS
AT DARU KHULA AREA NIZAMPUR

PROJECT: SURVEY AND EXPLORATION
OF LIMESTONE AND CLAY
DEPOSITS FOR BASING
CEMENT PLANTS IN NWFP.

HOLE NO. NC - 6

CORE SIZE - PX

TOTAL BORE DEPTH

20 M

CORE RECOVERY

20 M

PERCENTAGE OF CORE
RECOVERY

100 %

DATE: NOVEMBER, 96

LOGGED BY:

SELC PROJECT, SDA

FORM (M)	TO (M)	DESCRIPTION
0.00	17.00	Shale - Brownish colored, fine grained, compact, siliceous along with upper and lower contact with sandstone and calcareous shale.
17.00	20.00	Shale - Brownish colour with sandy clay, loose.

SARHAD DEVELOPMENT AUTHORITY
CORE DRILLING IN CLAY DEPOSITS
AT DARU KHULA AREA NIZAMPUR

PROJECT: SURVEY AND EXPLORATION
OF LIMESTONE AND CLAY
DEPOSITS FOR BASING
CEMENT PLANTS IN NWFP.

HOLE NO. - NC - 7

CORE SIZE - PX

TOTAL BORE DEPTH

20 M

CORE RECOVERY

20 M

PERCENTAGE OF CORE
RECOVERY

100 %

DATE: NOVEMBER, 96

LOGGED BY:

SELC PROJECT, SDA

FORM (M)	TO (M)	DESCRIPTION
0.00	9.5	Clay - Yellowish to gray in colour at surface, fine grained in depth. Re-deposited materials, pebbles, gravel, conglomerates are present.
9.5	20.00	Loose conglomerates and redeposited materials like pebbles are present.

SARHAD DEVELOPMENT AUTHORITY
CORE DRILLING IN CLAY DEPOSITS
AT DARU KHULA AREA NIZAMPUR

PROJECT: SURVEY AND EXPLORATION
OF LIMESTONE AND CLAY
DEPOSITS FOR BASING
CEMENT PLANTS IN NWFP.

HOLE NO. NC - 8

CORE SIZE - PX

TOTAL BORE DEPTH

10 M

CORE RECOVERY

8 M

PERCENTAGE OF CORE
RECOVERY

80 %

DATE: NOVEMBER, 96

LOGGED BY:

SELC PROJECT, SDA

FORM (M)	TO (M)	DESCRIPTION
0.00	8.00	Redeposited pebbly materials like conglomerates are observed, mostly fine grained and grey in colour. Pebbles are present upto 10m in depth.

1.11 RESERVES OF THE CLAY DEPOSITS AT DARU KHULA AREA NIZAMPUR DISTRICT NOWSHERA

The reserves of Clay deposits near Marooba village and Ghalib baba Ziarat were calculated to a tune of 1.026 m.m.t. Detail is as follow.

(A) MAROOPA AREA

Length of Clay Out Crop = 200 m
Average Width = 130 m
Average Depth = 15 m
Sp.Gravity = 2.2

Reserves = $200 \times 130 \times 15 \times 2.2 = 0.85 \text{ m.m.t}$

(B) GHALIB BABA ZIARAT AREA

Length of Clay Out Crop = 500 m
Average Width = 8 m
Average Depth = 20 m
Sp.Gravity = 2.2

Reserves = $500 \times 8 \times 20 \times 2.2 = 0.176 \text{ m.m.t}$

TOTAL $0.85 + 0.176 = 1.026 \text{ m.m.t}$

1.12 RAW MIX DESIGN AND BURNABILITY TEST STUDIES OF LIMESTONE AND CLAY DEPOSITS AT DARU KHULA AREA NIZAMPUR

The Raw Mix design and burnability studies of the Limestone and Clay deposits at Daru Khula area Nizampur were carried out by the Mineral Processing section of Mineral Testing Laboratory, SDA Peshawar.

For the said studies 5 Nos Limestone sample of 200 kg weight each and 5 Nos clay samples of 30kg each were provided to Mineral Testing Laboratory SDA.

A good quality clinker product suitable for cement manufacturing was produced by burning temperature of 1260 C° at grain size 106 Micron 55% passing of 25 minutes grinding at SiO₂ ratio (SR) 3.15% Alumina Ratio AR 2.99% and Lime saturation (LS) 87.26 at Ratio Mix of Limestone 59.00% and clay 40.30%.

Through the aforementioned studies it is clear that the physical calculation of the ratio mix design and also the Lime saturation ratio, silica ratio and Alumina Ratio are feasible parameters for installation of a cement plant on these deposits.

A detailed Burnability and Raw Mix design Laboratory test studies report has ben prepared by the Mineral Processing section of Mineral Testing Laboratory, SDA.

1.13 **INFRASTRUCTURE.**

The area is connected through a metalled road with Peshawar. Nizampur village is located at a distance of 32 kms in the South-West direction of Attock bridge. The nearest railway station is Khair Abad.

The main raw materials (Limestone and Clay/shales) are available near the main Nizampur-Kohat road.

A 132 kv Grid station is located near the Kahi village.

Good quality of Sub-soil water is available near the Limestone deposits. The water can also be pumped from the river Indus which is flowing near by the area.

Alternate tub-wells could be located on the bank of Indus river to get clean water.

The area is connected with the main G.T.road through the main Kohat Niampur road.

1.14 CONCLUSION AND RECOMMENDATIONS:

The Limestone and Clay deposits at Daru Khula area Nizampur were studied Geologically in detail. Geological and Contour Maps of these deposits were prepared on different scales.

These deposits were sampled. Core and Auger drilling both in Limestone and Clay deposits were carried out. All the chips/rock and core samples were analyzed for CaO, MgO, SiO₂, Al₂O₃, Fe₂O₃, SO₃, K₂O, Cl and L.O.I.

The analysis results are encouraging and are of cement grade. The Reserves of Limestone deposits at Daru Khula area were calculated to a tune of 210 m.m.t in proved category, which can run a cement plant of more than 200 years with a capacity of 3000 T.P.D.

Moreover the clay deposits which is an important additive is available near to the Limestone deposits.

The water which is an important component is available and the water table in the area is also present at shallow depth under the ground. The area is also connected through a series of metalled and unmetalled roads.

As the population is not dense and scarce so the environmental effects in the area by cement plant shall not be high.

The Daru Khula area is located in settled area of District, Nowshera so there would be no problem in acquisition of the land for installation of a cement plant in the area.

Keeping in view the above mentioned established parameters, it is recommended that a cement plant of 3000 T.P.D can be installed in the area. Which shall have a life for more than 200 years. As the area is backward so this would be helpful in the development of the area and shall provide job opportunities to the local as well as shall pay revenue to the Govt in the form of Royalty, Excise and other taxes.

**LIMESTONE AND CLAY DEPOSITS
AT SHAMUZAI-BABUZAI AREA
KATLANG
DISTRICT MARDAN N.W.F.P.**

2.

LIMESTONE AND CLAY DEPOSITS AT SHAMOZAI
BABUZAI AREA DISTRICT MARDAN

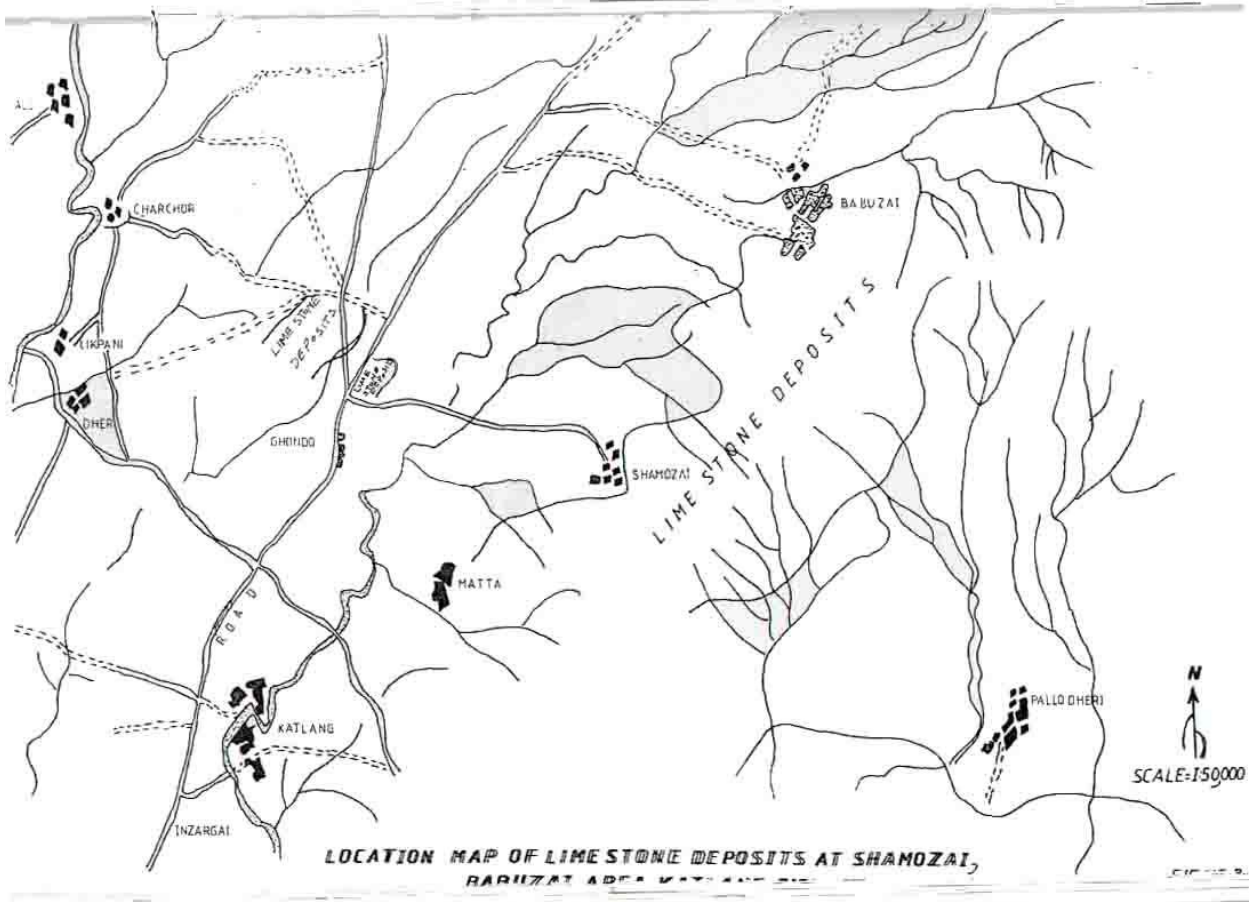
2.1 LOCATION AND ACCESSIBILITY

The Limestone and Clay deposits of Shamozaï-Babuzai area Katlang District Mardan are located near Shamozaï and Babuzai village on Topo sheet No. 43B/3. Survey of Pakistan. A location map of the area is prepared on scale 1:50,000. (fig-2.1)

The area is connected through a metalled road with Mardan and Peshawar covering a distance of 30 and 100 k.m respectively.

The area generally characterized by undulating topography with hills of high peaks in the North East direction.

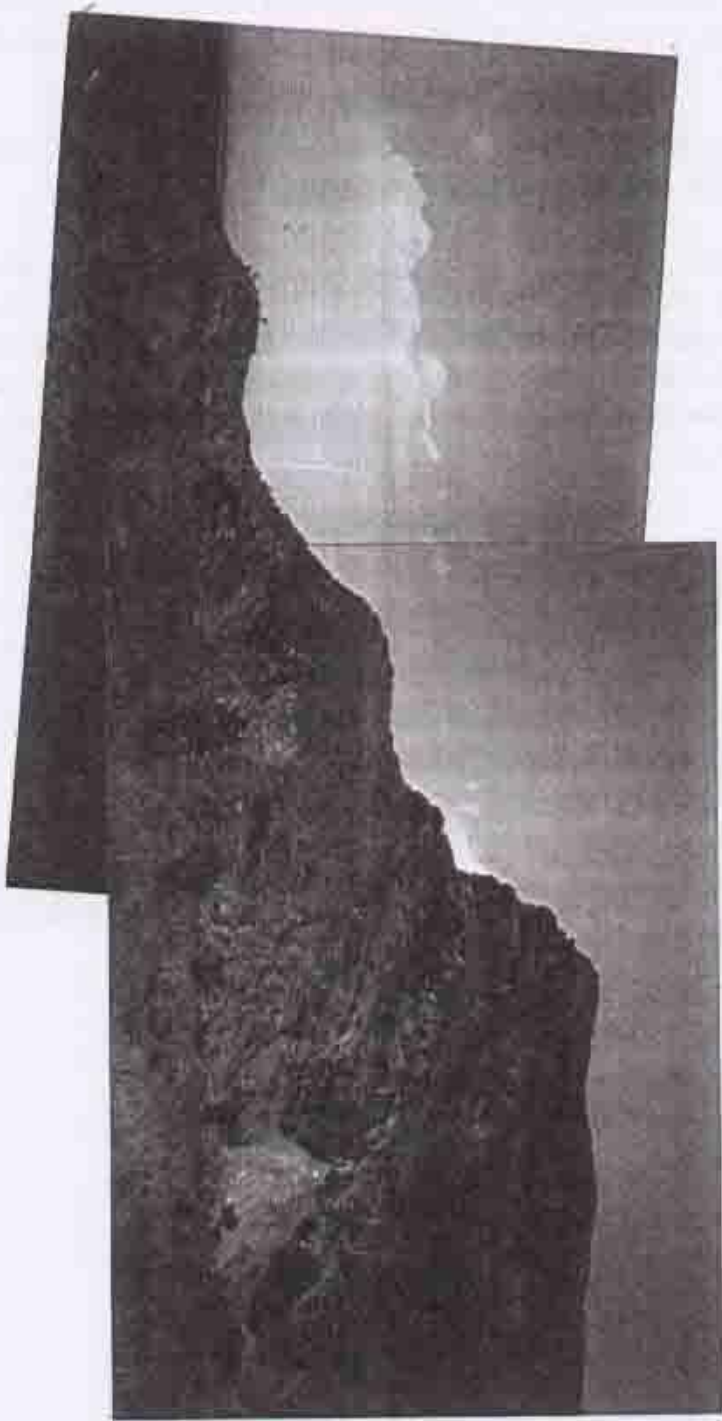
The area is characterized by cold winters and hot summer with poor rainfall.



LOCATION MAP OF LIME STONE DEPOSITS AT SHAMOZA, BABUZAI AREA KATLANG DISTRICT

SCALE: 1:50,000

A VIEW OF LIMESTONE EXPOSURE
AT SHAMOZAI-BABUZAI AREA KATIANG



2.2 TOPOGRAPHY AND CLIMATE

The area generally characterized by undulating topography with hills of high peaks in the North East direction. The area in the North West of Shamozaai and Babuzai villages is covered with residual soils. The elevation of the mountains in the area ranges from 780 meters to 1400 meters above sea level.

The topography bears a definite relation to the lithology and structure of the rocks exposed in the area.

The area is characterized by cold winter and hot summer. The hottest months of the year are June to August and the coldest months are December to February. In summer the temperature ranges from 25°C to 45°C. The area receives poor rain fall. The maximum rain fall is during the moon soon season.

2.3 GENERAL GEOLOGY

The rocks in the area belong to the lower Swat Bunair schistose group. The lower Swat Bunair Schistose group has been intruded by Swat granitic gneisses. Martin, et. al divided the lower Swat Bunair Schistose group in the following sub groups.

- a. Green Schists
- b. Phyllitic schists
- c. Marbles and calcareous schists
- d. Amphibolite Horizon
- e. Siliceous schists

The Limestone deposits of Shamozaï-Babuzai area Katlang have the upper contact with the Schists, while the lower contact is not exposed and is covered by Alluvium. The Limestone is medium to thick bedded striking in the North East direction while dipping in the South West direction.

Isoclinal folds, anticlines and synclines can be observed at places. Structurally lineations, folds, drag folds and other intraformational deformations, are present.

The folds are syntectonic and they reflect two predominant directions a North East ward and South West ward.

A general Geological map along with drill points locations in Limestone and Clay deposits is prepared on scale 1:50,000 and 1: 10,000(fig 2.2 &2.3).

2.4 CONTOUR SURVEY

The Contour Survey of the Limestone deposits at Shamozaï Babuzai area Katlang District Mardan was carried out with 25 meters contour interval on scale 1:500, 1:5000 and 1:10000 covering an area of about 3 Km to locate the drilling points in the Limestone deposits at different localities to calculate the reserves and to plan the open cut mining in future. The contour Survey shall also be helpful to locate the plant site in the area. A Contour map of the Limestone deposits at Shamozaï Babuzai area Katlang District Mardan on scale 1:10,000 is prepared (fig 2.5).

2.5

SAMPLING AND CHEMICAL ANALYSIS

A total 41 Nos chip/rock samples were collected from the Limestone deposits and 8 Nos clay samples were collected from the clay deposits at Shamozaï-Babuzai area Katlang Mardan. These samples have been analyzed at Mineral Testing Laboratory, SDA Peshawar, for CaO, MgO, SiO₂, Fe₂O₃, Al₂O₃, K₂O, Na₂O, Cl, SO₃ and L.O.I.

Results of chemical analysis are shown in the following table No.2. Most of the samples are high in CaO, and low in MgO content, which reveals the suitability of these deposits for cement grade.

TABLE- 2.1

ANALYSIS RESULTS OF CHIP AND ROCK SAMPLES
COLLECTED FROM THE LIMESTONE DEPOSITS AT
SHAMOZAI-BABUZAI AREA KATLANG

S.NO:	SAMPLE NO.	CaO %	MgO %	SiO ₂ %	Fe ₂ O ₃ %	Al ₂ O ₃ %	Na ₂ O %	K ₂ O %	Cl %	SO ₃ %	L.O.I %
1.	LS- 42	36.50	16.00	2.38	0.08	0.18	0.53	0.06	0.25	0.02	43.00
2.	LS- 43	32.92	18.89	1.56	0.07	0.93	0.59	0.06	0.20	0.18	44.00
3.	LS- 44	52.76	0.99	1.50	0.21	0.28	0.35	0.05	0.08	0.02	43.50
4.	LS- 45	52.86	1.08	0.98	0.08	0.56	0.57	0.05	0.10	0.02	42.81
5.	LS- 46	36.00	17.00	1.96	0.09	0.60	0.59	0.06	0.24	0.19	43.00
6.	LS- 47	37.00	17.50	1.00	0.09	0.28	0.30	0.07	0.21	0.18	43.00
7.	LS- 48	53.00	1.00	1.96	0.08	0.70	0.57	0.06	0.30	0.17	42.00
8.	LS- 49	53.46	1.15	1.50	0.10	0.64	0.35	0.07	0.20	0.16	42.32
9.	LS- 50	53.53	1.20	1.45	0.10	0.18	0.32	0.06	0.21	0.19	42.45
10.	LS- 51	52.64	1.65	1.62	0.15	0.60	0.40	0.10	0.24	0.02	42.33
11.	LS- 52	46.00	7.00	2.00	0.24	0.39	0.48	0.06	0.24	0.02	43.00
12.	LS- 53	50.17	1.80	1.90	0.14	0.37	0.59	0.06	0.28	0.02	43.68
13.	CL- 5	13.00	1.3	57.40	3.00	9.80	1.23	1.13	0.35	0.21	12.00
14.	CL- 6	12.50	2.00	56.00	3.28	10.33	2.00	1.70	0.31	0.16	11.50
15.	LSS- 142	52.20	1.50	2.12	0.85	0.37	0.18	0.03	0.17	0.20	42.18
16.	LSS- 143	51.50	1.50	2.20	0.28	0.24	0.15	0.02	0.14	0.50	42.10
17.	LSS- 144	49.00	1.16	8.10	0.56	0.28	0.17	0.03	0.14	0.20	39.43
18.	LSS- 145	47.93	1.82	8.20	0.46	0.48	0.18	0.03	0.17	0.25	38.88

S.NO:	SAMPLE NO,	CaO %	MgO %	SiO2 %	Fe2O3 %	Al2O3 %	Na2O%	K2O %	Cl %	SO3 %	L.O.T %
19.	LSS- 146	52.50	1.12	2.10	0.51	0.35	0.20	0.03	0.09	0.08	42.41
20.	LSS- 147	52.00	1.10	1.95	0.52	0.50	0.11	0.03	0.08	0.06	42.62
21.	LSS- 148	48.16	1.82	6.12	0.86	1.14	0.18	0.03	0.18	0.22	40.00
22.	LSS- 149	47.04	2.1	7.16	0.28	0.50	0.18	0.03	0.14	0.12	40.20
23.	LSS- 150	45.47	4.31	6.60	1.29	0.42	0.18	0.03	0.17	0.18	40.50
24.	LSS- 151	47.48	2.81	6.36	0.80	0.34	0.18	0.03	0.21	0.10	40.81
25.	LSS- 152	48.60	2.32	6.16	0.59	0.42	0.20	0.04	0.14	0.11	40.36
26.	LSS- 153	43.90	3.64	10.90	0.65	0.32	0.18	0.03	0.17	0.13	38.49
27.	LSS- 154	39.42	3.81	16.46	1.12	0.85	0.17	0.04	0.21	0.20	37.29
28.	LSS- 155	50.17	1.32	4.14	0.86	0.71	0.18	0.04	0.28	0.06	41.57
29.	LSS- 156	29.34	12.60	18.00	0.87	0.57	0.20	0.07	0.17	0.22	33.40
30.	LSS- 157	43.90	10.44	1.14	0.78	0.14	0.18	0.03	0.17	0.20	40.93
31.	LSS- 158	52.19	0.99	2.24	0.69	0.14	0.18	0.03	0.21	0.06	42.00
32.	LSS- 159	54.43	0.85	0.76	0.55	0.14	0.18	0.02	0.28	0.08	42.54
33.	KS- 1	53.32	2.12	0.46	0.05	0.12		0.38	0.08	0.01	43.37
34.	KS- 2	35.84	19.52	0.80	0.07	0.14		0.42	0.09	0.012	43.00
35.	KS- 3	54.00	2.00	0.04	0.07	0.12		0.40	0.08	0.014	43.00
36.	KS- 4	40.45	11.50	1.74	0.21	0.15		0.53	0.10	0.011	44.33
37.	KS- 5	49.05	0.66	9.00	0.32	0.14		0.42	0.07	0.012	38.71
38.	KG- 1	52.23	0.82	3.00	0.50	0.21		0.49	0.08	0.01	42.23
39.	KG- 2	52.00	0.99	4.00	0.61	0.23		0.50	0.06	0.011	41.00
40.	KB- 1	51.74	1.32	4.00	0.08	0.20		0.44	0.07	0.013	41.60
41.	KP- 1	53.00	1.00	1.62	0.32	0.14		0.46	0.05	0.012	43.00

2.6 PETROGRAPHY

Thin sections of all the samples (LS-42 to LS-53) were prepared and studied under the microscope to find the exact type of Limestone and also identifying the associated minerals. The microscopic study is also aided by staining tests.

Detail of the petrographic study is as follows

1. SAMPLE NO. LS-42.

Calcite, Dolomite.

Mostly echinoderms bioclasts. In some portion the calcite is recrystallized to form big grains. Recrystallized calcite (which is confirmed by staining) surrounds the Rhombohedral Dolomite grains. The dolomite is about 20-25 volume % on visual estimation.

This Limestone indicates that it is subjected to some stress as most of the calcite crystals are twinned which is a feature which may develop as a result of pressure & the twin planes can be seen to be slightly bent. The euhedral dolomite crystals shows a loosely interlocking network of euhedral dolomite crystals (unstained) with the inter-crystal spaces filled by a coarse sparry calcite cement which gives pink color by staining.

Rock name : Dolomitic Limestone.

2. SAMPLE NO. LS-43.

This is dolomite in which the original Limestone has been nearly totally replaced by dolomite. The result is a mosaic of subhedral to anhedral crystals. However in some portions shows a loosely-interlocking network of euhedral dolomite crystals with the inter-crystal spaces filled by a coarse sparry calcite cement.

Rock name : Dolomite.

3. **SAMPLE NO. LS-44.**

This is a Limestone in which the allochems are mainly pelloids (as they lack any internal structure), mostly circular to elliptical and averaging about 0.02 mm to 0.05 mm.

Styllolites are also present which also indicates presence of iron oxide and clay minerals. Near styllolites, the recrystallized calcite grains which are comparatively big size are present. Also some rhombohedral dolomite grains are also identified.

Rock name : Limestone.

4. **SAMPLE NO. LS-45.**

Very similar to Sample no LS-44, but in this case the recrystallization of calcite grains is more dominative, so may be termed as recrystallized Limestone as the calcite grains are very compact & cementing material is nearly absent. Some big Rhombohedral Dolomite grains are also present.

Rock name : Partially Recrystallized Limestone.

5. **SAMPLE NO. LS-46.**

The original calcite matrix has been wholly replaced by dolomite. Few pelloids have resisted dolomitization & are only partly replaced. Where replacement is incomplete, the euhedral rhomb-shaped crystals of dolomite are visible; while in other case where replacement is complete, the dolomite crystals have grown together & the euhedral shape is lost.

Rock name : Calcitic Dolomite.

6. SAMPLE NO. LS-47.

This is very fine grained and the outlines of the original allochems have been preserved as a ghost texture. Some bivalves or Mollusc fragments are also present which are filled with calcite.

Rock name : Dolomite or Magnesian Limestone.

7. SAMPLE NO. LS-48.

The rock is grain-supported with a spar cement. The sediment is loosely packed, suggesting that the cementation occurred before significant compaction. The allochems are a mixture of Oosparite according to Folk classification. Very few recrystallized calcite grains are also present along with some opaque minerals possibly Magnetite (?) & pyrite (?). The calcite is Ferroan calcite as confirmed by staining test which gives mauve-purple color.

Rock name : Limestone (Oosparite).

8. SAMPLE NO. LS-49.

This is also very similar to Sample no LS-48.

Rock name : Limestone (Oosparite).

9. SAMPLE NO. LS-50.

In this section, Tabulate coral-in which the corallite walls & thin tabulae are present, but absence of other internal structures. The fill was sparite cement which may be later recrystallized to form calcite grains.

Rock name : Partially Recrystallized Limestone.

10. **SAMPLE NO. LS-51.**

This is also similar to Sample no LS-50.

The calcite grains mostly surround the anhedral to subhedral quartz grains, also limonite is present.

Rock name : Partially Recrystallized Limestone.

11. **SAMPLE NO. LS-52.**

This is very fine grained Limestone. Iron oxide & quartz are also present in sufficient amount.

Rock name : Limestone.

12. **SAMPLE NO. LS-53.**

This is very fine grained Limestone.

Micro-stylolites are present. Few calcite grains are recrystallized. Few Rhombohedral Dolomite grains are also present.

Few octahedral opaque grains (Magnetite ?) are present. The recrystallized calcite grains are twinned which may develop as a result of some pressure.

Rock name : Limestone.

2.7. CORE DRILLING IN LIMESTONE DEPOSITS AT SHAMOZAI BABUZAI AREA KATLANG

Based on initial Exploration and analysis results the Limestone deposits at Shamozaï -Babuzai area Katlang were recommended for Core drilling. A total of 500 meters core drilling was made through 7 nos holes in different localities of these deposits.

All the Cores collected through core drilling were sampled in a way that 1 No sample was prepared from the core of 2.5 meters length of core and thus 184 Nos samples were prepared from the cores. These samples were analyzed for Cao, Mgo, Al₂O₃, Fe₂O₃, SiO₂, Na₂O, K₂O, SO₃, Cl and L.O.I The analysis results of these samples collected through core drilling are shown in the following Table No 2.2. (LS-1LS-7 are Core drill Holes Nos)

Table No 2.2
ANALYSIS RESULTS OF THE SAMPLES COLLECTED
THROUGH CORE DRILLING IN LIMESTONE DEPOSITS AT
SHAMOZAI-BABUZAI AREA KATLANG

S.NO.	SAMAMPLE NO	CaO %	MgO %	Al2O3 %	SiO2 %	Na2O %	K2O %	SO3 %	Cl %	L.O.I %
1	LSI- 1	51.19	1.16	0.15	4.48	0.10	0.02	0.20	0.09	41.54
2	LSI- 2	47.71	1.98	0.16	8.98	0.09	0.02	0.22	0.10	40.11
3	LSI- 3	49.95	2.15	0.17	5.52	0.09	0.02	0.18	0.11	41.20
4	LSI- 4	50.17	2.31	0.15	5.22	0.09	0.02	0.17	0.10	41.27
5	LSI- 5	49.28	1.98	0.15	6.16	0.10	0.04	0.15	0.08	41.35
6	LSI- 6	50.40	1.65	0.16	5.06	0.09	0.02	0.13	0.08	41.50
7	LSI- 7	51.96	1.15	0.17	2.60	0.10	0.02	0.11	0.07	42.68
8	LSI- 8	50.17	1.48	0.19	5.64	0.09	0.03	0.12	0.09	41.46
9	LSI- 9	50.62	1.32	0.17	4.85	0.10	0.02	0.14	0.07	41.57
10	LSI- 10	47.26	1.49	0.18	9.62	0.10	0.04	0.10	0.08	39.99
11	LSI- 11	49.72	1.98	0.16	5.02	0.10	0.02	0.11	0.07	41.48
12	LSI- 12	50.17	1.65	0.15	5.24	0.12	0.03	0.10	0.06	41.49
13	LSI- 13	52.19	1.15	0.14	3.38	0.09	0.02	0.11	0.08	41.52
14	LSI- 14	51.52	1.32	0.16	4.16	0.08	0.02	0.12	0.09	41.55
15	LSI- 15	50.40	1.48	0.16	5.02	0.08	0.02	0.10	0.10	41.44
16	LSI- 16	51.74	1.45	0.15	4.68	0.11	0.03	0.09	0.08	40.81

S.NO.	SAMAPLE NO	CaO %	MgO %	Al2O3 %	SiO2 %	Na2O %	K2O %	SO3 %	Cl %	L.O.I %
17	LSI- 17	51.52	1.58	0.15	3.82	0.10	0.02	0.08	0.08	41.80
18	LSI- 18	51.96	1.15	0.15	3.58	0.09	0.02	0.09	0.07	41.73
19	LSI- 19	50.40	1.32	0.13	5.12	0.09	0.02	0.07	0.06	41.36
20	LSI- 20	49.72	1.48	0.15	5.14	0.11	0.04	0.08	0.08	41.53
21	LSI- 21	49.95	1.81	0.15	4.28	0.10	0.02	0.09	0.07	41.57
22	LSI- 22	50.62	1.48	0.16	3.10	0.13	0.04	0.09	0.08	42.54
23	LSI- 23	51.07	1.98	0.15	3.86	0.07	0.02	0.08	0.09	41.74
24	LSI- 24	49.72	1.98	0.17	5.34	0.10	0.02	0.08	0.09	41.58
25	LSI- 25	51.07	1.32	0.17	4.20	0.09	0.02	0.07	0.08	41.76
26	LSI- 26	49.28	1.75	0.14	5.48	0.09	0.03	0.06	0.08	41.95
27	LSI- 27	49.95	1.58	0.15	4.00	0.10	0.05	0.08	0.07	42.83
28	LSI- 28	48.16	2.48	0.15	5.68	0.09	0.02	0.08	0.09	42.14
29	LS2- 1	49.50	0.18	0.11	6.24	0.37	0.10	0.19	0.13	42.51
30	LS2- 2	50.62	0.21	0.12	5.66	0.35	0.10	0.20	0.15	42.23
31	LS2- 3	51.64	0.23	0.11	4.78	0.37	0.10	0.17	0.12	41.98
32	LS2- 4	51.86	0.21	0.12	3.90	0.33	0.10	0.15	0.11	42.23
33	LS2- 5	52.56	0.24	0.12	3.52	0.36	0.06	0.14	0.14	42.41
34	LS2- 6	52.31	0.21	0.12	4.06	0.37	0.10	0.17	0.15	42.08
35	LS2- 7	52.20	0.19	0.12	4.08	0.37	0.10	0.16	0.16	42.07
36	LS2- 8	51.07	0.28	0.12	5.90	0.35	0.12	0.18	0.13	41.05
37	LS2- 9	51.98	0.26	0.11	4.22	0.37	0.11	0.20	0.11	41.73
38	LS2- 10	51.64	0.21	0.12	4.24	0.35	0.12	0.19	0.12	42.16
39	LS2- 11	52.41	0.23	0.12	4.04	0.35	0.10	0.17	0.14	41.97
40	LS2- 12	51.64	0.29	0.11	4.84	0.33	0.11	0.13	0.11	42.12
41	LS2- 13	51.52	0.31	0.12	4.60	0.32	0.11	0.12	0.13	41.68
42	LS2- 14	51.74	0.24	0.13	4.42	0.33	0.12	0.15	0.14	42.16
43	LS2- 15	52.64	0.23	0.11	3.92	0.33	0.11	0.14	0.16	42.06
44	LS2- 16	49.72	0.26	0.12	6.00	0.35	0.12	0.13	0.12	41.97
45	LS2- 17	50.62	0.23	0.12	5.98	0.33	0.12	0.12	0.13	41.85
46	LS2- 18	51.64	0.24	0.12	4.44	0.35	0.11	0.15	0.10	41.89
47	LS2- 19	51.41	0.31	0.12	5.12	0.33	0.12	0.12	0.11	41.76
48	LS2- 20	52.31	0.23	0.13	3.70	0.33	0.11	0.11	0.10	42.21
49	LS2- 21	50.17	0.29	0.13	5.18	0.30	0.12	0.13	0.12	42.44
50	LS2- 22	49.72	0.24	0.12	5.66	0.32	0.12	0.15	0.14	42.02
51	LS2- 23	49.16	0.24	0.12	5.82	0.32	0.11	0.18	0.18	42.04
52	LS2- 24	52.36	0.21	0.13	3.82	0.33	0.11	0.19	0.17	41.99
53	LS3- 1	50.02	2.48	0.12	4.50	0.45	0.03	0.17	0.18	41.41
54	LS3- 2	49.95	3.31	0.12	3.20	0.40	0.03	0.15	0.16	42.19
55	LS3- 3	49.67	2.62	0.12	3.80	0.47	0.03	0.18	0.14	42.48
56	LS3- 4	49.28	2.81	0.13	3.20	0.43	0.02	0.14	0.17	42.78
57	LS3- 5	50.40	2.81	0.12	3.26	0.45	0.02	0.15	0.16	42.37
58	LS3- 6	50.62	2.48	0.12	3.06	0.47	0.02	0.16	0.15	42.47
59	LS3- 7	48.04	3.64	0.12	4.16	0.43	0.02	0.14	0.13	42.75
60	LS3- 8	50.62	1.81	0.14	3.40	0.43	0.02	0.13	0.14	42.84

S.NO.	SAMAMPLE NO	CaO %	MgO %	Al2O3 %	SiO2 %	Na2O %	K2O %	SO3 %	Cl %	L.O.I %
61	LS3- 9	48.83	3.31	0.12	3.34	0.40	0.01	0.17	0.15	42.75
62	LS3- 10	49.28	2.81	0.11	3.68	0.41	0.02	0.16	0.17	42.33
63	LS3- 11	47.71	2.65	0.13	5.68	0.44	0.02	0.14	0.18	42.07
64	LS3- 12	49.28	2.12	0.12	5.34	0.43	0.03	0.12	0.15	41.83
65	LS3- 13	48.38	2.48	0.13	5.34	0.47	0.02	0.11	0.13	42.08
66	LS3- 14	48.16	3.48	0.13	5.12	0.49	0.03	0.13	0.12	41.89
67	LS3- 15	47.48	2.81	0.12	5.26	0.40	0.02	0.15	0.11	42.12
68	LS3- 16	48.16	2.48	0.13	6.02	0.43	0.04	0.18	0.10	41.92
69	LS3- 17	50.40	1.65	0.12	4.38	0.48	0.02	0.16	0.12	42.11
70	LS3- 18	51.41	1.65	0.12	3.00	0.51	0.02	0.14	0.13	42.23
71	LS3- 19	49.28	2.15	0.12	4.82	0.48	0.02	0.17	0.15	42.18
72	LS3- 20	49.50	1.82	0.13	5.34	0.44	0.03	0.13	0.12	41.78
73	LS3- 21	50.17	1.82	0.13	4.22	0.47	0.04	0.12	0.13	42.22
74	LS3- 22	50.40	1.58	0.12	4.60	0.47	0.02	0.14	0.12	42.03
75	LS3- 23	47.47	1.98	0.11	7.14	0.45	0.02	0.16	0.14	41.24
76	LS3- 24	51.29	1.15	0.13	4.40	0.45	0.03	0.15	0.13	41.76
77	LS3- 25	49.72	1.32	0.12	6.30	0.45	0.02	0.13	0.15	41.24
78	LS3- 26	46.12	2.48	0.12	6.96	0.44	0.12	0.15	0.14	41.64
79	LS4- 1	50.41	2.31	0.11	3.84	0.45	0.05	0.18	0.19	41.52
80	LS4- 2	51.55	2.31	0.11	3.02	0.45	0.03	0.15	0.17	42.08
81	LS4- 3	47.48	3.07	0.13	5.52	0.47	0.04	0.17	0.16	41.94
82	LS4- 4	51.64	2.15	0.10	2.32	0.40	0.03	0.16	0.14	42.34
83	LS4- 5	51.41	1.48	0.12	3.38	0.39	0.03	0.18	0.15	42.16
84	LS4- 6	51.41	1.48	0.11	3.58	0.49	0.04	0.17	0.17	42.15
85	LS4- 7	51.29	1.65	0.12	3.28	0.48	0.04	0.16	0.14	41.89
86	LS4- 8	51.52	2.31	0.11	3.08	0.45	0.04	0.15	0.15	41.73
87	LS4- 9	51.74	1.12	0.12	4.32	0.44	0.05	0.14	0.18	41.40
88	LS4- 10	51.41	1.31	0.12	3.92	0.43	0.03	0.16	0.14	41.88
89	LS4- 11	46.60	3.13	0.11	6.70	0.39	0.03	0.17	0.13	42.12
90	LS4- 12	50.40	1.98	0.12	4.62	0.47	0.05	0.14	0.12	41.81
91	LS4- 13	51.64	1.48	0.12	3.46	0.47	0.03	0.16	0.15	41.57
92	LS4- 14	51.74	1.81	0.11	3.22	0.44	0.04	0.15	0.17	41.92
93	LS4- 15	51.20	1.32	0.11	3.52	0.43	0.03	0.13	0.16	41.82
94	LS4- 16	50.17	2.18	0.11	4.00	0.40	0.02	0.15	0.18	42.28
95	LS4- 17	51.07	1.98	0.12	3.18	0.45	0.04	0.12	0.14	42.18
96	LS4- 18	51.20	1.98	0.11	2.94	0.45	0.03	0.14	0.12	42.50
97	LS4- 19	50.84	1.65	0.12	3.20	0.40	0.03	0.16	0.16	42.36
98	LS4- 20	50.62	2.05	0.11	3.68	0.43	0.03	0.15	0.13	42.88
99	LS4- 21	49.50	2.31	0.11	3.84	0.49	0.03	0.14	0.12	42.13
100	LS4- 22	51.02	1.48	0.11	3.98	0.45	0.03	0.13	0.11	42.61
101	LS4- 23	50.70	1.65	0.11	3.50	0.43	0.03	0.12	0.13	42.45
102	LS4- 24	50.17	1.75	0.12	3.94	0.44	0.02	0.14	0.15	42.51
103	LS4- 25	51.30	0.82	0.11	3.78	0.47	0.03	0.15	0.14	42.49
104	LS4- 26	51.74	1.32	0.12	3.26	0.45	0.03	0.12	0.13	42.35

S.NO.	SAMPLE NO	CaO %	MgO %	Al2O3 %	SiO2 %	Na2O %	K2O %	SO3 %	Cl %	L.O.I %
105	LS-5- 1	50.40	1.32	0.11	4.18	0.22	0.06	0.15	0.17	42.89
106	LS-5- 2	50.17	1.48	0.13	4.48	0.24	0.04	0.14	0.14	42.82
107	LS-5- 3	50.84	1.65	0.12	3.76	0.22	0.05	0.13	0.16	42.46
108	LS-5- 4	47.71	3.48	0.13	6.00	0.24	0.06	0.12	0.15	41.74
109	LS-5- 5	50.17	1.65	0.12	4.56	0.21	0.04	0.14	0.13	42.58
110	LS-5- 6	50.40	1.32	0.16	5.02	0.24	0.05	0.13	0.12	42.19
111	LS-5- 7	51.07	0.98	0.15	3.94	0.24	0.06	0.12	0.11	42.23
112	LS-5- 8	47.04	2.15	0.16	8.60	0.22	0.07	0.11	0.10	41.00
113	LS-5- 9	49.95	1.15	0.14	6.82	0.21	0.05	0.14	0.13	40.65
114	LS-5- 10	49.50	1.48	0.13	5.76	0.22	0.06	0.14	0.15	42.19
115	LS-5- 11	48.38	1.98	0.13	6.00	0.21	0.04	0.15	0.14	42.25
116	LS-5- 12	46.14	2.98	0.15	8.40	0.21	0.06	0.12	0.16	41.10
117	LS-5- 13	47.04	2.48	0.14	7.14	0.20	0.04	0.13	0.17	42.15
118	LS-5- 14	46.59	2.32	0.13	8.10	0.21	0.05	0.15	0.14	41.66
119	LS-5- 15	48.16	2.32	0.17	7.12	0.22	0.06	0.16	0.13	41.21
120	LS-5- 16	47.26	2.48	0.14	6.70	0.21	0.07	0.12	0.15	40.90
121	LS-5- 17	51.07	1.48	0.13	3.40	0.21	0.04	0.14	0.12	42.57
122	LS-5- 18	48.60	2.65	0.15	4.74	0.20	0.04	0.13	0.11	42.49
123	LS-5- 19	50.84	1.98	0.13	4.06	0.22	0.06	0.15	0.15	42.20
124	LS-5- 20	50.84	1.15	0.15	4.42	0.22	0.04	0.14	0.11	42.38
125	LS-5- 21	48.83	2.00	0.12	5.42	0.21	0.04	0.13	0.12	42.59
126	LS-5- 22	49.29	2.48	0.11	4.06	0.24	0.04	0.12	0.14	42.56
127	LS-5- 23	46.14	3.64	0.14	6.10	0.22	0.05	0.11	0.15	42.97
128	LS-5- 24	50.40	1.65	0.18	3.74	0.22	0.06	0.15	0.14	42.86
129	LS-5- 25	48.60	2.15	0.13	5.90	0.20	0.06	0.14	0.13	41.84
130	LS-5- 26	51.07	1.81	0.13	3.18	0.21	0.05	0.16	0.11	42.47
131	LS-5- 27	51.52	1.98	0.16	2.42	0.22	0.05	0.16	0.11	42.76
132	LS-5- 28	50.17	2.81	0.13	2.84	0.21	0.04	0.14	0.12	42.57
133	LS-5- 29	51.07	2.00	0.12	3.56	0.22	0.05	0.15	0.11	42.19
134	LS-5- 30	51.52	2.14	0.16	3.80	0.22	0.06	0.15	0.11	41.16
135	LS-5- 31	51.74	2.15	0.14	3.78	0.22	0.04	0.15	0.12	42.28
136	LS-5- 32	49.28	2.15	0.12	4.46	0.20	0.03	0.13	0.14	42.77
137	LS-5- 33	49.50	1.82	0.13	5.88	0.21	0.04	0.13	0.14	41.55
138	LS-5- 34	50.62	1.81	0.13	3.64	0.21	0.04	0.14	0.12	42.51
139	LS-6- 1	49.50	2.64	0.16	3.60	1.10	0.04	0.18	0.16	42.33
140	LS-6- 2	46.14	2.81	0.17	6.38	1.03	0.04	0.14	0.15	42.65
141	LS-6- 3	45.92	4.47	0.17	4.22	1.11	0.04	0.15	0.13	43.03
142	LS-6- 4	47.93	2.97	0.15	4.54	1.15	0.04	0.17	0.12	42.45
143	LS-6- 5	47.93	3.63	0.16	2.70	1.05	0.04	0.13	0.11	43.62
144	LS-6- 6	45.69	4.78	0.16	4.50	0.98	0.04	0.16	0.14	42.96
145	LS-6- 7	44.80	4.62	0.15	4.68	1.03	0.04	0.12	0.16	43.36
146	LS-6- 8	44.80	4.96	0.15	4.26	1.01	0.04	0.13	0.12	43.62
147	LS-6- 9	48.83	1.81	0.14	5.02	1.10	0.04	0.16	0.11	41.99

S.NO.	SAMAMPLE NO	CaO %	MgO %	Al2O3 %	SiO2 %	Na2O %	K2O %	SO3 %	Cl %	L.O.I %
148	LS-6- 10	49.28	1.65	0.16	5.04	1.21	0.04	0.18	0.10	41.75
149	LS-6- 11	48.38	1.48	0.15	5.02	1.13	0.04	0.14	0.14	42.64
150	LS-6- 12	45.69	3.80	0.17	5.14	1.10	0.05	0.13	0.12	42.58
151	LS-6- 13	49.50	2.48	0.14	2.04	1.21	0.04	0.15	0.13	43.30
152	LS-6- 14	50.62	1.81	0.12	2.26	1.15	0.03	0.17	0.11	43.36
153	LS-6- 15	48.16	3.63	0.14	3.42	1.02	0.03	0.16	0.14	43.04
154	LS-6- 16	46.59	3.47	0.13	4.60	1.05	0.03	0.18	0.13	43.13
155	LS-6- 17	48.38	2.64	0.14	4.66	1.07	0.03	0.14	0.15	42.40
156	LS-6- 18	45.92	3.15	0.16	6.74	1.07	0.04	0.12	0.12	42.01
157	LS-6- 19	48.38	1.48	0.13	5.80	1.03	0.04	0.11	0.13	41.94
158	LS-6- 20	47.93	3.14	0.15	5.08	1.05	0.04	0.18	0.14	41.83
159	LS-6- 21	45.92	3.15	0.16	6.60	1.02	0.04	0.17	0.16	41.88
160	LS-6- 22	47.04	2.81	0.14	5.84	1.07	0.03	0.18	0.12	42.07
161	LS-6- 23	43.68	3.64	0.16	8.30	1.01	0.06	0.16	0.13	41.71
162	LS-6- 24	47.04	3.31	0.15	5.18	1.14	0.05	0.17	0.12	42.22
163	LS-7- 1	50.62	1.65	0.12	3.38	0.21	0.01	0.15	0.17	42.85
164	LS-7- 2	49.28	1.98	0.13	4.60	0.20	0.01	0.12	0.16	42.49
165	LS-7- 3	45.92	5.63	0.14	3.78	0.21	0.01	0.14	0.17	43.25
166	LS-7- 4	47.04	4.63	0.13	3.68	0.22	0.01	0.16	0.14	43.14
167	LS-7- 5	49.50	3.64	0.12	2.84	0.24	0.02	0.13	0.15	42.27
168	LS-7- 6	48.16	3.97	0.14	3.86	0.21	0.01	0.12	0.16	42.46
169	LS-7- 7	49.05	3.15	0.12	4.42	0.21	0.01	0.14	0.13	41.84
170	LS-7- 8	47.48	2.81	0.13	5.22	0.22	0.02	0.13	0.14	41.80
171	LS-7- 9	49.28	2.02	0.11	4.28	0.24	0.28	0.15	0.15	42.77
172	LS-7- 10	49.72	2.32	0.12	4.24	0.20	0.04	0.12	0.15	42.36
173	LS-7- 11	50.62	2.15	0.11	3.46	0.25	0.02	0.14	0.16	42.57
174	LS-7- 12	47.04	5.61	0.13	2.26	0.21	0.01	0.16	0.17	43.40
175	LS-7- 13	48.38	3.97	0.12	3.16	0.22	0.01	0.13	0.17	42.77
176	LS-7- 14	46.14	4.97	0.14	4.58	0.18	0.01	0.15	0.16	42.96
177	LS-7- 15	47.48	2.48	0.13	6.84	0.20	0.01	0.14	0.16	40.90
178	LS-7- 16	48.16	3.64	0.12	4.72	0.21	0.01	0.13	0.15	42.13
179	LS-7- 17	48.16	3.15	0.12	5.28	0.21	0.01	0.13	0.16	41.74
180	LS-7- 18	46.36	4.47	0.13	5.48	0.20	0.02	0.15	0.14	42.27
181	LS-7- 19	46.59	4.14	0.13	5.66	0.21	0.01	0.15	0.13	42.05
182	LS-7- 20	49.28	2.98	0.12	4.76	0.20	0.02	0.12	0.12	41.80
183	LS-7- 21	47.93	3.48	0.14	4.78	0.21	0.03	0.16	0.15	42.35
184	LS-7- 22	49.28	2.98	0.12	4.34	0.20	0.01	0.12	0.13	42.23

2.8

**LOGGING OF CORE DRILLING IN LIMESTONE DEPOSITS AT DARU
KHULA AREA NIZAM PUR**

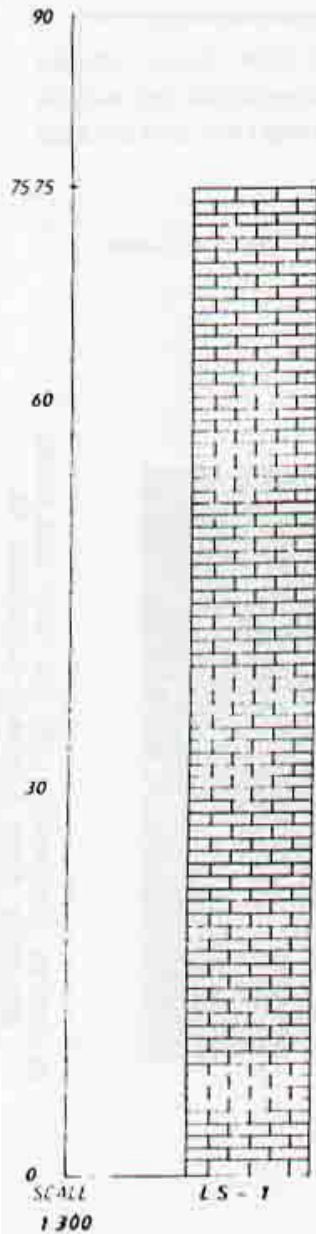
Logs of Core drill holes drilled in the Lime Stone deposits at Daru Khula area Nizampur have been prepared on scale 1:300 along with the analysis results of the samples collected through core drilling.

Description of each Core drilled hole is as follows.

SARHAD DEVELOPMENT AUTHORITY



SURVEY AND EXPLORATION OF LIMESTONE AND CLAY DEPOSITS IN N.W.F.P



S No	Sample No	CaO%	MgO%	Al ₂ O ₃ %	SiO ₂ %	Na ₂ O%	K ₂ O%	SO ₃ %	Cl %	L.O.I %
01	LS1- 1	51.19	1.16	0.15	4.48	0.10	0.02	0.20	0.09	41.54
02	LS1- 2	47.71	1.98	0.16	8.98	0.09	0.02	0.22	0.10	40.11
03	LS1- 3	49.95	2.15	0.17	5.52	0.09	0.02	0.18	0.11	41.20
04	LS1- 4	50.17	2.31	0.15	5.22	0.09	0.02	0.17	0.10	41.27
05	LS1- 5	49.28	1.98	0.15	6.16	0.10	0.04	0.15	0.08	41.35
06	LS1- 6	50.40	1.65	0.16	5.06	0.09	0.02	0.13	0.08	41.50
07	LS1- 7	51.96	1.15	0.17	2.60	0.10	0.02	0.11	0.07	42.68
08	LS1- 8	50.17	1.48	0.19	3.64	0.09	0.03	0.12	0.09	41.66
09	LS1- 9	50.62	1.32	0.17	4.85	0.10	0.02	0.14	0.07	41.57
10	LS1- 10	47.26	1.49	0.18	9.62	0.10	0.04	0.10	0.08	39.99
11	LS1- 11	49.72	1.98	0.16	5.02	0.10	0.02	0.11	0.07	41.68
12	LS1- 12	50.17	1.65	0.15	5.24	0.12	0.03	0.10	0.06	41.49
13	LS1- 13	52.19	1.15	0.14	3.38	0.09	0.02	0.11	0.08	41.52
14	LS1- 14	51.52	1.32	0.16	4.16	0.08	0.02	0.12	0.09	41.55
15	LS1- 15	50.40	1.48	0.16	5.02	0.08	0.02	0.10	0.10	41.44
16	LS1- 16	51.74	1.45	0.15	4.68	0.11	0.03	0.09	0.08	40.81
17	LS1- 17	51.52	1.58	0.15	3.82	0.10	0.02	0.08	0.08	41.80
18	LS1- 18	51.96	1.15	0.15	3.58	0.09	0.02	0.09	0.07	41.73
19	LS1- 19	50.40	1.32	0.13	5.12	0.09	0.02	0.07	0.06	41.36
20	LS1- 20	49.72	1.48	0.15	5.14	0.11	0.04	0.08	0.08	41.53
21	LS1- 21	49.95	1.81	0.15	4.28	0.10	0.02	0.09	0.07	41.57
22	LS1- 22	50.62	1.48	0.16	3.10	0.13	0.04	0.09	0.08	42.54
23	LS1- 23	51.07	1.98	0.15	3.86	0.07	0.02	0.08	0.09	41.74
24	LS1- 24	49.72	1.98	0.17	5.34	0.10	0.02	0.08	0.09	41.58
25	LS1- 25	51.07	1.32	0.17	4.20	0.09	0.02	0.07	0.08	41.76
26	LS1- 26	49.28	1.75	0.14	5.48	0.09	0.03	0.06	0.08	41.95
27	LS1- 27	49.95	1.58	0.15	4.00	0.10	0.05	0.08	0.07	42.83
28	LS1- 28	48.16	2.48	0.15	5.68	0.09	0.02	0.08	0.09	42.14
	Average Values	50.88	1.58	0.15	4.97	0.09	0.02	0.11	0.06	41.55

GEO LOG OF CORE DRILL HOLE NO-1 AND ITS CHEMICAL ANALYSIS SHAMOZAI-BAB-UZAI AREA KATLANG DISTT MARDAN

SARHAD DEVELOPMENT AUTHORITY
CORE DRILLING IN LIMESTONE DEPOSIT
AT SHAMOZAI-BABUZAI AREA KATLANG

PROJECT: SURVEY AND EXPLORATION
 OF LIMESTONE AND CLAY
 DEPOSITS FOR BASING
 CEMENT PLANTS IN NWFP.

HOLE NO. LS - 1

CORE SIZE - NX

TOTAL BORE DEPTH
 75.75 M

CORE RECOVERY
 66.95 M

PERCENTAGE OF CORE
 RECOVERY
 88.38%

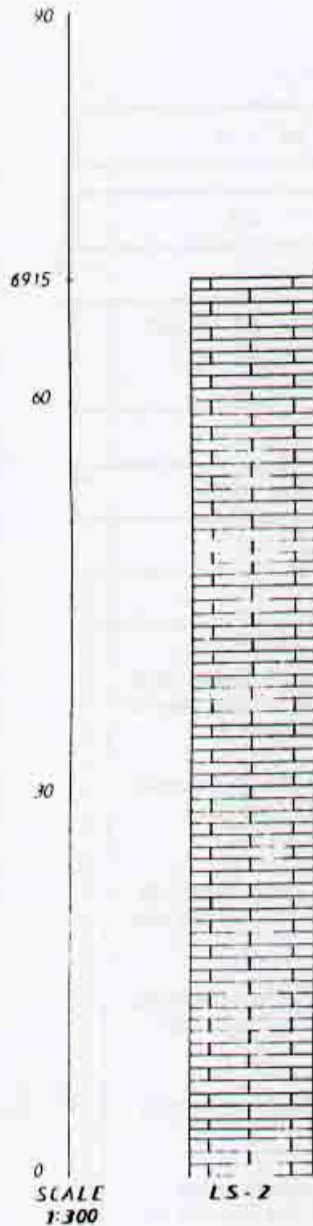
DATE: June, 1996 LOGGED BY: SELC PROJECT, SDA

FORM (M)	TO (M)	DESCRIPTION
0.00	7.70	Marbalized Limestone along with Lenses of mica schists, fine grained, compact, hard, siliceous medium bedded. Fractured & jointed at places. pyrite crystals are observed in recovered core. Lenticular calcite veins are abundant. Topaz crystals are also observed in calcite veinlets.
7.70	18.95	Marbalized Limestone, grey colour, fine grained, medium bedded, highly fractured and jointed. Lenticular calcite veins are present. At places mica schists is filled in with joints. Pyrite crystals are also observed.
18.95	35.62	Grey colored marbalized Limestone of Bunair Schistose group. Fine to medium grained compact, hard, jointed medium bedded along with lenticular calcite veinlets. Siliceous at the depth of 27 to 30 m.
35.62	49.61	Marbalized siliceous limestone, compact, hard and crystalline medium bedded, fine grained. Lenticular calcite veinlets are present. Thin lenses of micaceous schists are observed in the joints. Pyrite crystals are also observed in a few recoveries.
49.61	60.29	Marbalized grey colored Limestone, fine grained, compact, hard, medium bedded, siliceous. Lenticular calcite veins are also observed.
60.29	75.75	Grey colour siliceous Limestone of Bunair schistose group. Compact, hard, medium bedded, fine grained, calcite lenticular veinlets.

SARHAD DEVELOPMENT AUTHORITY



SURVEY AND EXPLORATION OF LIMESTONE AND
CLAY DEPOSITS IN N.W.F.P



S NO	Sample No	CaO%	MgO%	Al ₂ O ₃ %	SiO ₂ %	Na ₂ O%	K ₂ O%	SO ₃ %	L%	L.O.I%
01	LS2-1	49.50	0.18	0.11	6.24	0.37	0.10	0.19	0.13	42.51
02	LS2-2	50.62	0.21	0.12	5.66	0.35	0.10	0.20	0.15	42.23
03	LS2-3	51.64	0.23	0.11	4.78	0.37	0.10	0.17	0.12	41.98
04	LS2-4	51.86	0.21	0.12	3.90	0.33	0.10	0.15	0.11	42.23
05	LS2-5	52.56	0.24	0.12	3.52	0.36	0.06	0.14	0.14	42.41
06	LS2-6	52.31	0.21	0.12	4.06	0.37	0.10	0.17	0.15	42.08
07	LS2-7	52.20	0.19	0.12	4.08	0.37	0.10	0.16	0.16	42.07
08	LS2-8	51.07	0.28	0.12	5.90	0.35	0.12	0.18	0.13	41.05
09	LS2-9	51.98	0.26	0.11	4.22	0.37	0.11	0.20	0.11	41.73
10	LS2-10	51.64	0.21	0.12	4.24	0.35	0.12	0.19	0.12	42.16
11	LS2-11	52.41	0.23	0.12	4.04	0.35	0.10	0.17	0.14	41.97
12	LS2-12	51.64	0.29	0.11	4.84	0.33	0.11	0.13	0.11	42.12
13	LS2-13	51.52	0.31	0.12	4.60	0.32	0.11	0.12	0.13	41.68
14	LS2-14	51.74	0.24	0.13	4.42	0.33	0.12	0.15	0.14	42.16
15	LS2-15	52.64	0.23	0.11	3.92	0.33	0.11	0.14	0.16	42.06
16	LS2-16	49.72	0.26	0.12	6.00	0.35	0.12	0.13	0.12	41.97
17	LS2-17	50.62	0.23	0.12	5.98	0.33	0.12	0.12	0.13	41.85
18	LS2-18	51.64	0.24	0.12	4.44	0.35	0.11	0.15	0.10	41.89
19	LS2-19	51.41	0.31	0.12	5.12	0.33	0.12	0.12	0.11	41.76
20	LS2-20	52.31	0.23	0.13	3.70	0.33	0.11	0.11	0.10	42.21
21	LS2-21	50.17	0.29	0.13	5.18	0.30	0.12	0.13	0.12	42.44
22	LS2-22	49.72	0.24	0.12	5.66	0.32	0.12	0.15	0.14	42.02
23	LS2-23	49.16	0.24	0.12	5.82	0.32	0.11	0.18	0.18	42.04
24	LS2-24	52.36	0.21	0.13	3.82	0.33	0.11	0.19	0.17	41.99
	Average Values	51.35	0.24	0.12	4.59	0.34	0.10	0.15	0.13	42.02

GEO LOG OF CORE DRILL HOLE NO-2 AND
ITS CHEMICAL ANALYSIS SHAMOZAI-BABO
UZAI AREA KATLANG DISTT MARDAN.

SARHAD DEVELOPMENT AUTHORITY
CORE DRILLING IN LIMESTONE DEPOSIT
AT SHAMOZAI-BABUZAI AREA KATLANG

PROJECT: SURVEY AND EXPLORATION
 OF LIMESTONE AND CLAY
 DEPOSITS FOR BASING
 CEMENT PLANTS IN NWFP.

HOLE NO. LS - 2

CORE SIZE - NX

TOTAL BORE DEPTH

69.15 M

CORE RECOVERY

59.97 M

PERCENTAGE OF CORE
 RECOVERY

86.72%

DATE: July, 1996

LOGGED BY:

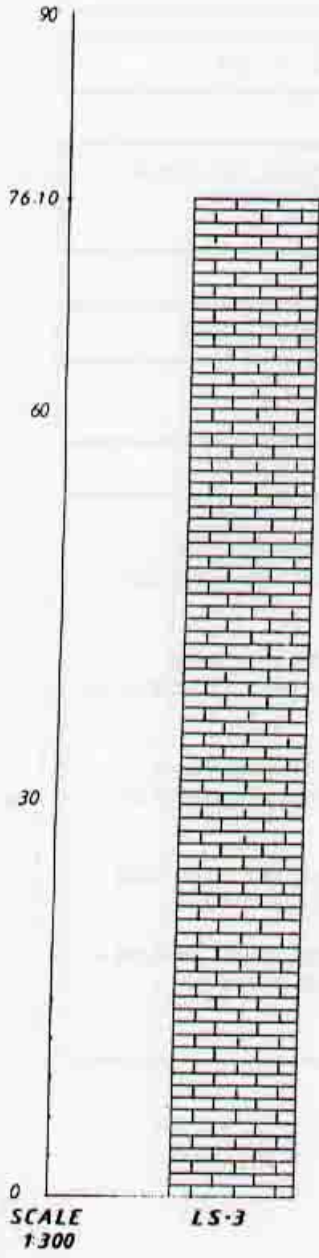
SELC PROJECT, SDA

FORM (M)	TO (M)	DESCRIPTION
0.00	17.20	Light grey colored marbalized, compact, fined grained Limestone. Medium to thick bedded, lenticular calcite veinlets are present. Topaz crystals are also observed in the calcite veinlets. Pyrite crystals, are observed in core recovery.
17.20	20.58	Light grey colour, schistose group marbalized Limestone. Thick bedded, jointed & fractured, fine grained, siliceous. Calcite crystals in calcite veins are observed. Pyrite crystals are also observed in a few core recoveries.
20.58	40.84	Marbalized Limestone, fine grained, compact, thick bedded, siliceous along with calcite veins. Topaz crystals observed in calcite veins pyrite crystals are also observed in a few core recoveries.
40.84	52.74	Marbalized Limestone, fine grained, compact thick bedded, jointed and fractured, siliceous along with calcite veins. Mica schists lenses observed with in the Limestone.
52.74	58.73	Marbalized Limestone, fine grained, siliceous compact. Medium bedded along with calcite lenticular veinlets.
58.73	69.15	Marbalized Limestone compact, siliceous, hard, jointed and fractured medium bedded. Minute calcite veinlets, mica & calcite cubic crystals are observed in joints.

SARHAD DEVELOPMENT AUTHORITY



SURVEY AND EXPLORATION OF LIMESTONE AND CLAY DEPOSITS IN N.W.F.P



S No.	Sample No	CaO%	MgO%	Al ₂ O ₃ %	SiO ₂ %	Na ₂ O%	K ₂ O%	SO ₃ %	Cl %	L.O.I.%
01	LS3-1	50.02	2.48	0.12	4.50	0.45	0.03	0.17	0.18	41.41
02	LS3-2	49.95	3.31	0.12	3.20	0.40	0.03	0.15	0.16	42.19
03	LS3-3	49.67	2.62	0.12	3.80	0.47	0.03	0.18	0.14	42.48
04	LS3-4	49.28	2.81	0.13	3.20	0.43	0.02	0.14	0.17	42.78
05	LS3-5	50.40	2.81	0.12	3.26	0.45	0.02	0.15	0.16	42.37
06	LS3-6	50.62	2.48	0.12	3.06	0.47	0.02	0.16	0.15	42.47
07	LS3-7	48.04	3.64	0.12	4.16	0.43	0.02	0.14	0.13	42.75
08	LS3-8	50.62	1.81	0.14	3.40	0.43	0.02	0.13	0.14	42.84
09	LS3-9	48.83	3.31	0.12	3.34	0.40	0.01	0.17	0.15	42.75
10	LS3-10	49.28	2.81	0.11	3.68	0.41	0.02	0.16	0.17	42.33
11	LS3-11	47.71	2.65	0.13	5.68	0.44	0.02	0.14	0.18	42.07
12	LS3-12	49.28	2.12	0.12	5.34	0.43	0.03	0.12	0.15	41.83
13	LS3-13	48.38	2.48	0.13	5.34	0.47	0.02	0.11	0.13	42.08
14	LS3-14	48.16	3.48	0.13	5.12	0.49	0.03	0.13	0.12	41.89
15	LS3-15	47.48	2.81	0.12	5.26	0.40	0.02	0.15	0.11	42.12
16	LS3-16	48.16	2.48	0.13	6.02	0.43	0.04	0.18	0.10	41.92
17	LS3-17	50.40	1.65	0.12	4.38	0.48	0.02	0.16	0.12	42.11
18	LS3-18	51.41	1.65	0.12	3.00	0.51	0.02	0.14	0.13	42.23
19	LS3-19	49.28	2.15	0.12	4.82	0.48	0.02	0.17	0.15	42.18
20	LS3-20	49.50	1.82	0.13	5.34	0.44	0.03	0.13	0.12	41.78
21	LS3-21	50.17	1.82	0.13	4.22	0.47	0.04	0.12	0.13	42.22
22	LS3-22	50.40	1.58	0.12	4.60	0.47	0.02	0.14	0.12	42.03
23	LS3-23	47.47	1.98	0.11	7.14	0.45	0.02	0.16	0.14	41.24
24	LS3-24	51.29	1.15	0.13	4.40	0.45	0.03	0.15	0.13	41.76
25	LS3-25	49.72	1.32	0.12	6.30	0.45	0.02	0.13	0.15	41.24
26	LS3-26	46.12	2.48	0.12	6.96	0.44	0.12	0.15	0.14	41.64
Average Values		49.29	2.37	3.23	4.59	0.44	0.02	0.14	0.14	42.10

GEO LOG OF CORE DRILL HOLE NO-3 AND ITS CHEMICAL ANALYSIS SHAMOZAI-BAB-UZAI AREA KATLANG DISTT MARDAN.

SARHAD DEVELOPMENT AUTHORITY
CORE DRILLING IN LIMESTONE DEPOSIT
AT SHAMOZAI-BABUZAI AREA KATLANG

PROJECT: SURVEY AND EXPLORATION
 OF LIMESTONE AND CLAY
 DEPOSITS FOR BASING
 CEMENT PLANTS IN NWFP.

HOLE NO. LS - 3

CORE SIZE - NX

TOTAL BORE DEPTH

76.10 M

CORE RECOVERY

65.00 M

PERCENTAGE OF CORE
 RECOVERY

85.52%

DATE: August, 1996

LOGGED BY:

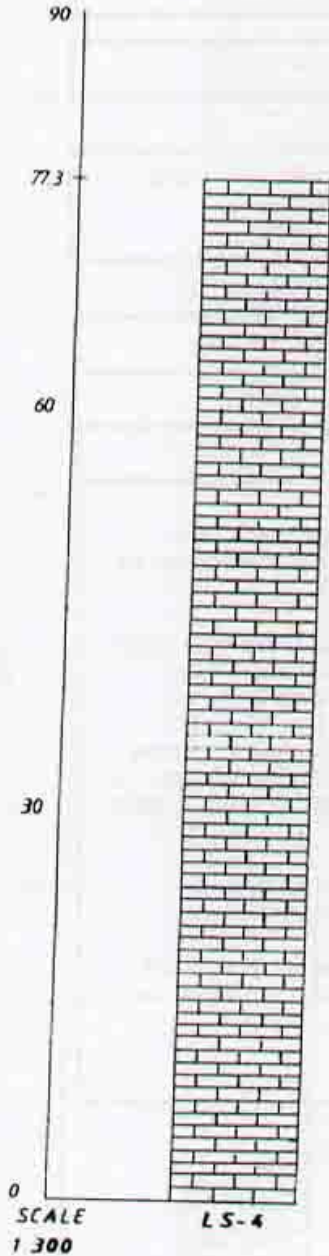
SELC PROJECT, SDA

FROM (M)	TO (M)	DESCRIPTION
0.00	17.20	Marbalized Limestone, compact, hard, fine grained, medium to thick bedded. Lenticular calcite veinlets are abundant. Fractures and joints are filled with early material in the upper two meters.
17.20	34.00	Marbalized Limestone, compact, hard, crystalline medium bedded. Lenticular veinlets are observed. The mica schists along with pyrite crystals are observed in the fractures and joints.
34.00	51.65	Marbalized Limestone, fine grained, compact, crystalline, jointed fractured, medium bedded. Along with lenticular veinlets siliceous lenses of Limestone are also observed.
51.65	68.35	Marbalized Limestone, siliceous, medium bedded compact, hard, crystalline along with calcite lenticular veinlets calcite veinlets are minute in this area.
68.35	76.10	Marbalized Limestone, compact hard, crystalline medium bedded, highly fractured & jointed fine grained along with calcite veinlets, in lenticular structure.

SARHAD DEVELOPMENT AUTHORITY



SURVEY AND EXPLORATION OF LIMESTONE AND CLAY DEPOSITS IN N.W.F.P



S. No	Sample No	CaO %	MgO %	Al ₂ O ₃	SiO ₂ %	Na ₂ O %	K ₂ O %	SO ₃ %	Cl %	LOI %
01	LS4-1	50.41	2.31	0.11	3.84	0.45	0.05	0.18	0.19	41.52
02	LS4-2	51.55	2.31	0.11	3.02	0.45	0.03	0.15	0.17	42.08
03	LS4-3	47.48	3.07	0.13	5.52	0.47	0.04	0.17	0.16	41.94
04	LS4-4	51.64	2.15	0.10	2.32	0.40	0.03	0.16	0.14	42.34
05	LS4-5	51.41	1.48	0.12	3.38	0.39	0.03	0.18	0.15	42.16
06	LS4-6	51.41	1.48	0.11	3.58	0.49	0.04	0.17	0.17	42.15
07	LS4-7	51.29	1.65	0.12	3.28	0.48	0.04	0.16	0.14	41.89
08	LS4-8	51.52	2.31	0.11	3.08	0.45	0.04	0.15	0.15	41.73
09	LS4-9	51.74	1.12	0.12	4.32	0.44	0.05	0.14	0.18	41.40
10	LS4-10	51.41	1.31	0.12	3.92	0.43	0.03	0.16	0.14	41.88
11	LS4-11	46.60	3.13	0.11	6.70	0.39	0.03	0.17	0.13	42.12
12	LS4-12	50.40	1.98	0.12	4.62	0.47	0.05	0.14	0.12	41.81
13	LS4-13	51.64	1.48	0.12	3.46	0.47	0.03	0.16	0.15	41.57
14	LS4-14	51.74	1.81	0.11	3.22	0.44	0.04	0.15	0.17	41.92
15	LS4-15	51.20	1.32	0.11	3.52	0.43	0.03	0.13	0.16	41.82
16	LS4-16	50.17	2.18	0.11	4.00	0.40	0.02	0.15	0.18	42.28
17	LS4-17	51.07	1.98	0.12	3.18	0.45	0.04	0.12	0.14	42.18
18	LS4-18	51.20	1.98	0.11	2.94	0.45	0.03	0.14	0.12	42.50
19	LS4-19	50.84	1.65	0.12	3.20	0.40	0.03	0.16	0.16	42.36
20	LS4-20	50.62	2.05	0.11	3.68	0.43	0.03	0.15	0.13	42.88
21	LS4-21	49.50	2.31	0.11	3.84	0.49	0.03	0.14	0.12	42.13
22	LS4-22	51.02	1.48	0.11	3.98	0.45	0.03	0.13	0.11	42.61
23	LS4-23	50.20	1.65	0.11	3.50	0.43	0.03	0.12	0.13	42.45
24	LS4-24	50.17	1.75	0.12	3.94	0.44	0.02	0.14	0.15	42.51
25	LS4-25	51.30	0.82	0.11	3.28	0.47	0.03	0.15	0.14	42.49
26	LS4-26	51.74	1.32	0.12	3.26	0.45	0.03	0.12	0.13	42.35
	Average Values	50.76	6.87	0.11	3.73	0.44	0.03	0.14	0.14	42.12

GEO LOG OF CORE DRILL HOLE NO-4 AND ITS CHEMICAL ANALYSIS SHAMOZAI-BAB-UZAI AREA KATLANG DISTT. MARDAN.

SARHAD DEVELOPMENT AUTHORITY
CORE DRILLING IN LIMESTONE DEPOSIT
AT SHAMOZAI-BABUZAI AREA KATLANG

PROJECT: SURVEY AND EXPLORATION OF LIMESTONE AND CLAY DEPOSITS FOR BASING CEMENT PLANTS IN NWFP.	HOLE NO. LS - 4
	CORE SIZE - NX

TOTAL BORE DEPTH 77.3 M	CORE RECOVERY 65.00 M	PERCENTAGE OF CORE RECOVERY 84.08%
----------------------------	--------------------------	---------------------------------------

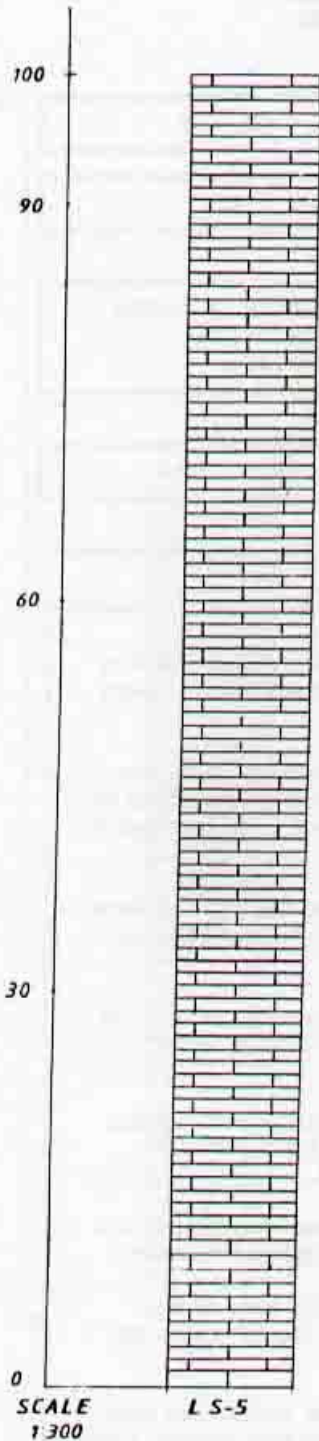
DATE: August, 1996	LOGGED BY:	SELC PROJECT, SDA
--------------------	------------	-------------------

FORM (M)	TO (M)	DESCRIPTION
0.00	16.00	Marbalized Limestone, compact, hard siliceous, crystalline, medium to thick bedded, lenticular veinlets of calcite are abundant. Joints and fractures are also observed.
16.00	35.9	Marbalized Limestone, fine grained, compact, crystalline, hard, lenticular calcite veinlets are abundant medium bedded fractures are also filled in with marly material and schistose material. Pyrite crystals are also observed.
35.9	52.9	Marbalized Limestone, compact, hard, crystalline fine grained. Lenses of coarse grained Limestone are also observed in the marbalized thick bedded Limestone. Lenticular calcite veinlets are abundant. Marbalized Limestone is medium to thick bedded.
52.9	70.15	Marbalized Limestone fine grained crystalline compact, hard, medium bedded, lenticular calcite veinlets are less. Calcite is also deposited in joints.
70.15	77.33	Marbalized Limestone fine to medium grained crystalline, compact, hard, little sil. Siliceous medium bedded. Calcite veinlets are lenticular in structures are also observed.

SARHAD DEVELOPMENT AUTHORITY



SURVEY AND EXPLORATION OF LIMESTONE AND
CLAY DEPOSITS IN N.W.F.P



S. No	Sample No	CaO _z	MgO _z	Al ₂ O ₃	SiO ₂	Na ₂ O _z	K ₂ O _z	SO ₃	Cl	LOI %
01	LSS-1	50.40	1.32	0.11	4.18	0.22	0.06	0.15	0.17	42.89
02	LSS-2	50.17	1.48	0.13	4.48	0.24	0.04	0.14	0.14	42.82
03	LSS-3	50.84	1.65	0.12	3.76	0.22	0.05	0.13	0.16	42.46
04	LSS-4	47.71	3.48	0.13	6.00	0.24	0.06	0.12	0.15	41.74
05	LSS-5	50.17	1.65	0.12	4.56	0.21	0.04	0.14	0.13	42.58
06	LSS-6	50.40	1.32	0.16	5.02	0.24	0.05	0.13	0.12	42.19
07	LSS-7	51.07	0.98	0.15	3.94	0.24	0.06	0.12	0.11	42.23
08	LSS-8	47.04	2.15	0.16	8.60	0.22	0.07	0.11	0.10	41.00
09	LSS-9	49.95	1.15	0.14	6.82	0.21	0.05	0.14	0.13	40.65
10	LSS-10	49.50	1.48	0.13	5.76	0.22	0.06	0.14	0.15	42.19
11	LSS-11	48.38	1.38	0.13	6.00	0.21	0.04	0.15	0.14	42.25
12	LSS-12	46.14	2.98	0.15	8.40	0.21	0.06	0.12	0.16	41.10
13	LSS-13	47.04	2.48	0.14	7.14	0.20	0.04	0.13	0.17	42.15
14	LSS-14	46.59	2.32	0.13	8.10	0.21	0.05	0.15	0.14	41.66
15	LSS-15	48.16	2.32	0.17	7.12	0.22	0.06	0.16	0.13	41.21
16	LSS-16	47.26	2.48	0.14	6.70	0.21	0.07	0.12	0.15	40.90
17	LSS-17	51.07	1.48	0.13	3.40	0.21	0.04	0.14	0.12	42.52
18	LSS-18	48.60	2.65	0.15	4.74	0.20	0.04	0.13	0.11	42.49
19	LSS-19	50.84	1.98	0.13	4.06	0.22	0.06	0.15	0.15	42.20
20	LSS-20	50.84	1.15	0.15	4.42	0.22	0.04	0.14	0.11	42.38
21	LSS-21	48.83	2.00	0.12	5.42	0.21	0.04	0.13	0.12	42.59
22	LSS-22	49.29	2.48	0.11	4.06	0.24	0.04	0.12	0.14	42.56
23	LSS-23	46.14	3.64	0.14	6.10	0.22	0.05	0.11	0.15	42.97
24	LSS-24	50.40	1.65	0.18	3.74	0.22	0.06	0.15	0.14	42.86
25	LSS-25	48.60	2.15	0.13	5.90	0.20	0.06	0.14	0.13	41.84
26	LSS-26	51.07	1.81	0.13	3.18	0.21	0.05	0.16	0.11	42.47
27	LSS-27	51.52	1.98	0.16	2.42	0.22	0.05	0.16	0.11	42.76
28	LSS-28	50.17	2.81	0.13	2.84	0.21	0.04	0.14	0.12	42.57
29	LSS-29	51.07	2.00	0.12	3.56	0.22	0.05	0.15	0.11	42.19
30	LSS-30	51.52	2.14	0.16	3.80	0.22	0.06	0.15	0.11	41.16
31	LSS-31	51.74	2.15	0.14	3.78	0.22	0.04	0.15	0.12	42.28
32	LSS-32	49.28	2.15	0.12	4.46	0.20	0.03	0.13	0.14	42.77
33	LSS-33	49.50	1.82	0.13	5.88	0.21	0.04	0.13	0.14	41.55
34	LSS-34	50.62	1.81	0.13	3.64	0.21	0.04	0.14	0.12	42.51
	Average Values	49.46	2.01	0.13	5.14	0.21	0.04	0.13	0.13	42.13

GEO LOG OF CORE DRILL HOLE NO-5 AND
ITS CHEMICAL ANALYSIS SHAMOZAI-BAB-
UZAI AREA KATLANG DISTT. MARDAN.

**SARHAD DEVELOPMENT AUTHORITY
CORE DRILLING IN LIMESTONE DEPOSIT
AT SHAMOZAI-BABUZAI AREA KATLANG**

PROJECT: SURVEY AND EXPLORATION
OF LIMESTONE AND CLAY
DEPOSITS FOR BASING
CEMENT PLANTS IN NWFP.

HOLE NO. LS - 5

CORE SIZE - NX

TOTAL BORE DEPTH

100 M

CORE RECOVERY

80.00 M

PERCENTAGE OF CORE
RECOVERY

80.00%

DATE: Sept: 1996

LOGGED BY:

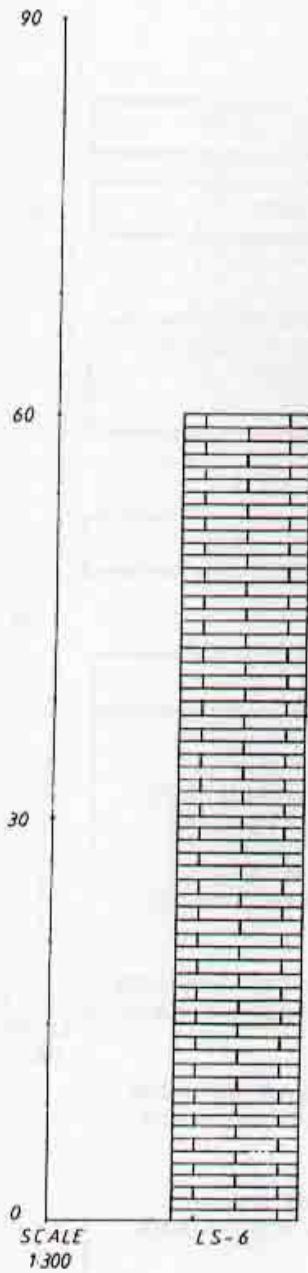
SELC PROJECT, SDA

FORM (M)	TO (M)	DESCRIPTION
0.00	10.86	Grey colour marbalized Limestone fine grained medium to thick bedded. Lenticular calcite veins are common in white colour compact, hard. Schists lenses in joints are also common.
10.86	24.64	Light gray to gray colour marbalized limestone of Bunair Schistose group. Fine grained, crystalline, hard, compact, calcite veinlets in lenticular structure are common. Medium to thick bedded. Marly material and schistose lenses are common in joints and fracture.
24.64	38.80	Gray colour marbalized limestone, crystalline, fine grained thin bedded at places. Highly fractured and jointed, calcite veinlets are common, joints and fractures are filled with mica schists and siliceous lenses.
38.80	51.08	Marbalized limestone, fine grained, thin bedded. Calcite veinlets. Siliceous the lenses of mica schist are observed along with joints and fractures. Pyrite crystals are also observed.
51.08	68.77	Crystalline, marbalized, limestone fine grained, compact highly jointed. Medium bedded, lenticular calcite veinlets are observed. Pyrite crystals are also observed. Disseminated siliceous lenses are also observed.
68.77	80.65	Marbalized, gray colour, crystalline limestone, fine grained compact, hard, thin to medium bedded, siliceous with calcite veinlets. Pyrite crystals are common.
80.65	91.20	Marbalized crystalline limestone, fine grained compact hard, lenses of mica schist. Medium bedded, pyrite crystals are also observed. Calcite veinlets are minor. Highly fractured and jointed at places.
91.20	100.20	Marbalized, crystalline gray colour limestone fine grained, compact, hard along with siliceous lenses. Joints and fractures are filled with marly material. Lenses of mica schists are observed. Pyrite crystals are also observed.

SARHAD DEVELOPMENT AUTHORITY



SURVEY AND EXPLORATION OF LIMESTONE AND
CLAY DEPOSITS IN N.W.F.P



S. No.	Sample No	CaO _%	MgO _%	Al ₂ O ₃ _%	SiO ₂ _%	Na ₂ O _%	K ₂ O _%	SO ₃ _%	Cl _%	L.O.I _%
01	LS6-1	49.50	2.64	0.16	3.60	1.10	0.04	0.18	0.16	42.33
02	LS6-2	46.14	2.81	0.17	3.38	1.03	0.04	0.14	0.15	42.65
03	LS6-3	45.92	4.47	0.17	4.22	1.11	0.04	0.15	0.13	43.03
04	LS6-4	47.93	2.97	0.15	4.54	1.15	0.04	0.17	0.12	42.45
05	LS6-5	47.93	3.63	0.16	2.70	1.05	0.04	0.13	0.11	43.62
06	LS6-6	45.69	4.78	0.16	4.50	0.98	0.04	0.16	0.14	42.96
07	LS6-7	44.80	4.62	0.15	4.68	1.03	0.04	0.12	0.16	43.36
08	LS6-8	44.80	4.96	0.15	4.26	1.01	0.04	0.13	0.12	43.62
09	LS6-9	43.83	1.81	0.14	5.02	1.10	0.04	0.16	0.11	41.99
10	LS6-10	49.28	1.65	0.16	5.04	1.21	0.04	0.18	0.10	41.75
11	LS6-11	48.38	1.48	0.15	5.02	1.13	0.04	0.14	0.14	42.64
12	LS6-12	45.69	3.80	0.17	5.14	1.10	0.05	0.13	0.12	42.58
13	LS6-13	49.50	2.48	0.14	2.04	1.21	0.04	0.15	0.13	43.30
14	LS6-14	50.62	1.81	0.12	2.26	1.15	0.03	0.17	0.11	43.36
15	LS6-15	48.16	3.63	0.14	3.42	1.02	0.03	0.16	0.14	43.04
16	LS6-16	46.59	3.47	0.13	4.60	1.05	0.03	0.18	0.13	43.13
17	LS6-17	48.38	2.64	0.14	4.66	1.07	0.03	0.14	0.15	42.40
18	LS6-18	45.92	3.15	0.16	6.74	1.07	0.04	0.12	0.12	42.01
19	LS6-19	43.38	1.48	0.13	5.80	1.03	0.04	0.11	0.13	41.94
20	LS6-20	47.93	3.14	0.15	5.08	1.05	0.04	0.18	0.14	41.83
21	LS6-21	45.92	3.15	0.16	6.60	1.02	0.04	0.17	0.16	41.38
22	LS6-22	47.04	2.81	0.14	5.84	1.07	0.03	0.18	0.12	42.07
23	LS6-23	43.68	3.64	0.16	8.30	1.01	0.06	0.16	0.13	41.71
24	LS6-24	47.04	3.31	0.15	5.18	1.14	0.05	0.17	0.12	42.22
	Average Values.	46.83	3.09	0.15	4.69	1.07	0.03	0.17	0.13	42.55

GEO LOG OF CORE DRILL HOLE NO-6 AND
ITS CHEMICAL ANALYSIS SHAMOZAI-BAB-
UZAI AREA KATLANG DISTT. MARDAN.

SARHAD DEVELOPMENT AUTHORITY
CORE DRILLING IN LIMESTONE DEPOSIT
AT SHAMOZAI-BABUZAI AREA KATLANG

PROJECT: SURVEY AND EXPLORATION
 OF LIMESTONE AND CLAY
 DEPOSITS FOR BASING
 CEMENT PLANTS IN NWFP.

HOLE NO. LS - 6

CORE SIZE - NX

TOTAL BORE DEPTH
 60.00 M

CORE RECOVERY
 51.10 M

PERCENTAGE OF CORE
 RECOVERY
 85.16%

DATE: Sept: 1996

LOGGED BY:

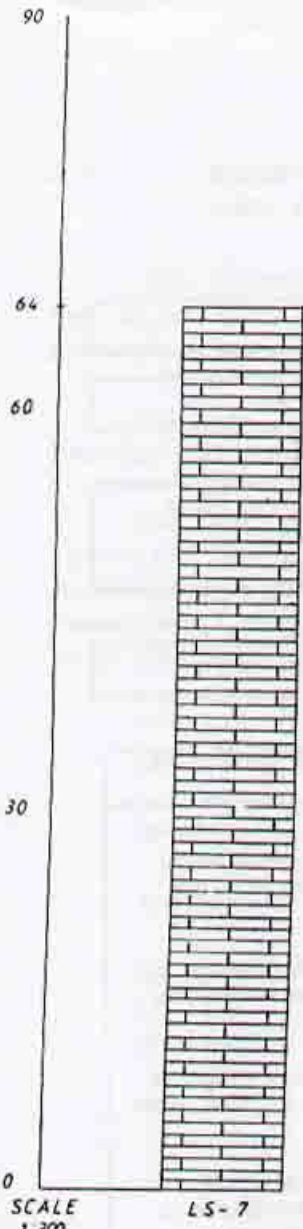
SELC PROJECT, SDA

FORM (M)	TO (M)	DESCRIPTION
0.00	9.40	Gray colour marbalized limestone. Fine grained, compact, hard, jointed and fractured along with calcite veinlets of lenticular structure. Medium to thick bedded along with siliceous limestone lenses.
9.40	23.70	Gray colour marbalized limestone. Fine grained, compact, hard, medium bedded, fractures and joints are filled with mica schists. Calcite crystals and veinlets are also abundant.
23.70	34.72	Marbalized, crystalline, gray colour, limestone, fine grained compact, hard medium bedded joints and fractures are filled with marly material. Lenticular calcite veinlets are also abundant.
34.72	46.85	Gray colour crystalline, marbalized limestone, fine grained compact, hard medium bedded. Highly fractured and jointed at places. Lenticular calcite veinlets are minor.
46.85	60.00	Limestone, marbalized, fine grained, compact, hard medium bedded, fractured & jointed. Joints are filled with clay materials, siliceous, no calcite veinlets. Pyrite crystals are observed.

SARHAD DEVELOPMENT AUTHORITY



SURVEY AND EXPLORATION OF LIMESTONE AND CLAY DEPOSITS IN N.W.F.P



S. No	Sample No	CaO %	MgO %	Al ₂ O ₃ %	SiO ₂ %	Na ₂ O %	K ₂ O %	SO ₃ %	Cl %	LOI %
01	LS7-1	50.62	1.65	0.12	3.38	0.21	0.01	0.15	0.17	42.85
02	LS7-2	49.28	1.98	0.13	4.60	0.20	0.01	0.12	0.16	42.49
03	LS7-3	45.92	5.63	0.14	3.78	0.21	0.01	0.14	0.17	43.25
04	LS7-4	47.04	4.63	0.13	3.68	0.22	0.01	0.16	0.14	43.14
05	LS7-5	49.50	3.64	0.12	2.84	0.24	0.02	0.13	0.15	42.27
06	LS7-6	48.16	3.97	0.14	3.86	0.21	0.01	0.12	0.16	42.46
07	LS7-7	49.05	3.15	0.12	4.42	0.21	0.01	0.14	0.13	41.86
08	LS7-8	47.48	2.81	0.13	5.22	0.22	0.02	0.13	0.14	41.80
09	LS7-9	49.28	2.02	0.11	4.28	0.24	0.02	0.15	0.15	42.77
10	LS7-10	49.72	2.32	0.12	4.24	0.20	0.04	0.12	0.15	42.36
11	LS7-11	50.62	2.15	0.11	3.46	0.25	0.02	0.14	0.16	42.57
12	LS7-12	47.04	5.61	0.13	2.26	0.21	0.01	0.16	0.17	43.40
13	LS7-13	48.38	3.97	0.12	3.16	0.22	0.01	0.13	0.17	42.77
14	LS7-14	46.14	4.97	0.14	4.58	0.18	0.01	0.15	0.16	42.96
15	LS7-15	47.48	2.48	0.13	6.84	0.20	0.01	0.14	0.16	40.90
16	LS7-16	48.16	3.64	0.12	4.72	0.21	0.01	0.13	0.16	42.13
17	LS7-17	48.16	3.15	0.12	5.28	0.21	0.01	0.13	0.16	41.74
18	LS7-18	46.36	4.47	0.13	5.48	0.20	0.02	0.15	0.14	42.27
19	LS7-19	46.59	4.14	0.13	5.66	0.21	0.01	0.15	0.13	42.05
20	LS7-20	49.28	2.98	0.12	4.76	0.20	0.02	0.12	0.12	41.80
21	LS7-21	47.93	3.48	0.14	4.78	0.21	0.03	0.16	0.15	42.35
22	LS7-22	49.28	2.98	0.12	4.34	0.20	0.01	0.12	0.13	42.23
Average Values		50.39	3.44	0.12	4.34	0.21	0.01	0.13	0.15	42.38

GEO LOG OF CORE DRILL HOLE NO-7 AND ITS CHEMICAL ANALYSIS SHAMOZAI-BAB-UZAI AREA KATLANG DISTT. MARDAN.

SCALE 1:300

LS-7

**SARHAD DEVELOPMENT AUTHORITY
CORE DRILLING IN LIMESTONE DEPOSIT
AT SHAMOZAI-BABUZAI AREA KATLANG**

**PROJECT: SURVEY AND EXPLORATION
OF LIMESTONE AND CLAY
DEPOSITS FOR BASING
CEMENT PLANTS IN NWFP.**

HOLE NO. LS - 7

CORE SIZE - NX

TOTAL BORE DEPTH

64.00 M

CORE RECOVERY

52.00 M

**PERCENTAGE OF CORE
RECOVERY**

81.75%

DATE: Sept: 1996

LOGGED BY:

SELC PROJECT, SDA

FORM (M)	TO (M)	DESCRIPTION
0.00	11.13	Limestone, marbalized, crystalline, hard, compact, fine grained, medium bedded. White colour lenticular calcite veinlets, joints and fractures are filled with marly material medium bedded.
11.13	22.08	Limestone, Gray colour, marbalized, crystalline fine grained, thin to medium bedded, highly fractured and jointed. Calcite veinlets are present in lenticular structure. Siliceous limestone lenses are also observed.
22.08	31.29	Limestone, marbalized, fine to medium grained compact, hard, calcite veinlets in lenticular structure. Limestone is crystalline, highly jointed & fractured. Joints and fractures are filled with mica schists.
31.29	42.11	Gray colour limestone, marbalized, compact, hard, crystalline, fine grained. Medium bedded, with siliceous limestone lenses. Pyrite crystals are observed in few are recoveries calcite veinlets are abundant. Joints are filled with micaceous schistose materials.
42.11	64.00	Limestone, marbalized, thin to medium bedded, highly fractured & jointed. Fine grained, compact, hard at places. White colour lenticular. Calcite veinlets are present.

2.9 RESERVES OF THE LIMESTONE DEPOSITS AT SHAMOZAI-BABUZAI
AREA KATLANG DISTRICT MARDAN N.W.F.P

The Limestone is fine grained, highly fractured and jointed and light grey in color. Beds of yellowish grey color are also present at places.

The Lime Stone deposits are exposed in between Shamozaï and Babuzai villages near Katlang district Mardan N.W.F.P.

The Inferred reserves of these deposits were calculated initially to a tune of 105 m.m.t. The depth of the Limestone deposits was proved to 110 meters through core drilling and the reserves of these deposits were estimated to a tune of 103.5 m.m.t with the following measurement.

Length of Limestone outcrops	=	1200 m
Depth	=	110 m
Thickness	=	280 m.
Sp.gravity	=	2.8
Tonnage = 2500 x 200 x 50 x 2.8	=	103.5.m.m.t

2.10 CLAY DEPOSITS AT SHAMOZAI-BABUZAI AREA KATLANG DISTRICT,
MARDAN.

Clay is one of the most important additives used in manufacturing of portland cement. Clay is a fine grained earthy material which is a mixture of different minerals. Clay is a hydrated silicate with a defined chemical composition and crystal structure.

Raw materials used for manufacture of portland cement should contain 70 - 75 % Cao, and 20 - 25 % of clayey substance.

A huge deposits of several Km² of clay is present at the foot hills of Shamozaï Babuzai Limestone deposits in the North West direction.

The analysis results of the clay are favorable for cement manufacturing.

The area is drained by canals of the swat river and due to the availability of water the plain having fine clay is being used as agriculture land.

8 Nos clay samples (CL-5 and CL-6 and CLS-28-CLS-33) were collected from these clay deposits, and were analyzed for Cao, Mgo, Sio₂, Fe₂O₃, Al₂O₃, Na₂O, K₂O, Cl and L.O.I. content. (Table - 2.3)

The analysis results of these samples are showing Cao 12.75%, Mgo 1.6%, Sio₂ 56.70%, Fe₂O₃ 3.14%, Al₂O₃ 10.07%, Na₂O 1.61%, K₂O 1.41%, Cl 0.33%, So₃ 0,19% and L.O.I. 11.75% in average (Table No 2.3).

As shown by the chemical analysis results of the clay samples, the clay is suitable for cement grade.

Table No 2.3

**ANALYSIS RESULTS OF CLAY SAMLES COLLECTED
FROM THE CLAY DEPOSITS AT SHAMOZAI-BABUZAI
AREA-NIZAMPUR**

S.NO.	SAMPLE NO.	CaO %	MgO %	SiO2 %	Fe2O3 %	Al2O3 %	Na2O%	K2O %	Cl %	SO3 %	L.O.I %
1.	CL-5	13.00	1.30	57.40	3.00	9.8	1.23	1.13	0.35	0.21	12.00
2.	CL-6	12.5	2.00	56.00	3.28	10.33	2.00	1.70	0.31	0.16	11.50
3.	CLS- 28	12.08	3.31	49.40	4.43	13.30	0.68	1.80	0.49	0.55	13.28
4.	CLS- 29	10.18	3.31	51.00	4.57	14.20	0.71	1.92	0.53	0.73	12.55
5.	CLS- 30	10.08	1.82	56.20	4.14	13.10	0.55	1.68	0.64	0.85	10.32
6.	CLS- 31	7.84	2.32	59.60	5.29	14.80	0.74	2.04	0.52	0.50	5.83
7.	CLS- 32	8.85	1.65	59.00	5.43	14.20	0.70	1.92	0.43	0.39	6.99
8.	CLS- 33	8.63	1.82	58.00	5.71	14.40	0.68	2.04	0.31	0.49	7.72

2.11 AUGER AND CORE DRILLING IN CLAY DEPOSITS AT SHAMOZAI-
BABUZAI AREA KATLANG DISTRICT MARDAN

To check the quality of clay deposits at Daru Khula area Nizampur at more depth 100 meters Auger and 150 meters Core drilling was carried out in the clay deposits at Shamozaibabuzai area Katlang.

26 Nos samples (AHS-1 to AHS-26) were collected through Auger drilling and 6 Nos samples (NCS-1 to NCS-6) were collected through Core drilling. These samples were analyzed for CaO, MgO, SiO₂, Fe₂O₃, Al₂O₃, K₂O, Na₂O, SO₃, Cl and L.O.I. The chemical analysis results are shown in the following table No 2.4.

Table No 2.4

**ANALYSIS RESULTS OF CLAY SAMPLES COLLECTED FROM
THE CLAY DEPOSITS AT SHAMOZAI-BABUZAI AREA
KATLANG THROUGH AUGER AND CORE DRILLING**

S.NO:	SAMPLE NO.	CaO %	MgO %	SiO ₂ %	Fe ₂ O ₃ %	Al ₂ O ₃ %	Na ₂ O %	K ₂ O %	Cl %	SO ₃ %	L.O.I %
1.	AHS- 1	11.32	3.15	47.60	4.86	11.30	1.21	3.01	0.53	0.69	15.55
2.	AHS- 2	9.08	2.65	51.80	4.71	12.10	1.21	3.13	0.62	0.52	13.52
3.	AHS- 3	8.30	2.98	51.20	4.57	12.10	1.34	2.89	0.59	0.47	14.91
4.	AHS- 4	8.51	2.81	50.20	5.29	13.30	1.48	3.61	0.46	0.51	13.16
5.	AHS- 5	9.40	3.31	50.40	4.57	12.30	1.21	2.77	0.48	0.59	14.56
6.	AHS- 6	8.96	2.98	51.60	4.43	12.60	1.34	3.01	0.51	0.49	13.52
7.	AHS- 7	7.61	3.31	52.30	4.14	11.80	1.48	3.37	0.54	0.37	13.57
8.	AHS- 8	7.58	3.31	52.20	4.71	12.60	1.34	3.13	0.63	0.35	13.58
9.	AHS- 9	7.84	3.31	53.00	4.71	12.50	1.48	3.13	0.67	0.31	12.55
10.	AHS- 10	8.90	3.48	52.00	4.86	11.70	1.34	3.13	0.51	0.35	13.12
11.	AHS- 11	9.08	2.98	51.20	4.71	11.80	1.34	3.01	0.49	0.31	14.51
12.	AHS- 12	8.85	3.31	54.40	4.43	12.60	0.67	1.20	0.50	0.49	12.61
13.	AHS- 13	29.52	1.49	22.70	1.42	8.40	0.32	0.65	0.54	0.47	33.74
14.	AHS- 14	18.95	3.48	38.00	3.28	11.20	0.63	1.02	0.58	0.53	21.55
15.	AHS- 15	19.41	3.15	38.80	4.00	11.40	0.67	1.07	0.55	0.56	19.93
16.	AHS- 16	16.47	2.81	45.20	3.43	13.30	0.71	1.14	0.64	0.42	15.31
17.	AHS- 17	19.04	2.81	40.60	3.71	10.50	0.68	1.08	0.62	0.39	20.14
18.	AHS- 18	10.30	3.31	49.60	4.28	15.10	0.71	1.20	0.60	0.34	14.15

S.NO:	SAMPLE NO.	CaO %	MgO %	SiO2 %	Fe2O3 %	Al2O3 %	Na2O %	K2O %	Cl %	SO3 %	L.O.I %
19.	AHS- 19	8.96	2.48	54.60	4.28	12.30	0.68	1.32	0.52	0.45	13.76
20.	AHS- 20	8.08	2.81	52.80	4.71	16.50	0.70	1.32	0.57	0.51	11.42
21.	AHS- 21	10.64	2.98	52.00	3.14	15.00	0.74	1.20	0.47	0.53	12.60
22.	AHS- 22	9.40	2.65	52.80	4.71	14.60	0.72	1.20	0.45	0.45	12.46
22.	AHS- 23	8.09	3.31	51.40	4.14	16.40	0.74	1.32	0.44	0.39	13.30
23.	AHS- 24	8.51	3.48	53.40	4.28	13.90	0.76	1.20	0.41	0.33	13.07
24.	AHS- 25	9.85	3.48	51.90	4.14	13.50	0.78	1.32	0.49	0.40	13.41
25.	AHS- 26	9.40	3.15	52.20	4.14	14.80	0.84	1.20	0.51	0.44	12.73
26.	AHS- 27	9.42	3.81	51.60	4.00	14.30	0.83	1.32	0.55	0.48	13.18

SARHAD DEVELOPMENT AUTHORITY
CORE DRILLING IN CLAY DEPOSITS AT
AT SHAMOZAI-BABUZAI AREA KATLANG

PROJECT: SURVEY AND EXPLORATION
 OF LIMESTONE AND CLAY
 DEPOSITS FOR BASING
 CEMENT PLANTS IN NWFP.

HOLE NO. SC - 1

CORE SIZE - PX

TOTAL BORE DEPTH

20 M

CORE RECOVERY

20 M

PERCENTAGE OF CORE
 RECOVERY

100 %

DATE: NOVEMBER, 96

LOGGED BY:

SELC PROJECT, SDA

FROM (M)	TO (M)	DESCRIPTION
0.00	17.00	Sandy Clay, fine to medium grained, loss alluvium deposits, soapy when wet. Moisture content content is increased in depth.
17.00	20.00	Silty Clay continued as above, observed calcite grains in depth.

SARHAD DEVELOPMENT AUTHORITY
 CORE DRILLING IN CLAY DEPOSITS
 AT SHAMOZAI-BABUZAI AREA KATLANG

PROJECT: SURVEY AND EXPLORATION
 OF LIMESTONE AND CLAY
 DEPOSITS FOR BASING
 CEMENT PLANTS IN NWFP.

HOLE NO. SC - 2

CORE SIZE - PX

TOTAL BORE DEPTH

20 M

CORE RECOVERY

20 M

PERCENTAGE OF CORE
 RECOVERY

100 %

DATE: NOVEMBER, 96

LOGGED BY:

SELC PROJECT, SDA

FROM (M)	TO (M)	DESCRIPTION
0.00	8.00	Silty Clay, fine grained, compact, loss at surface. Soapy in wet condition.
8.00	15.00	Silty, observed calcite cemented material.
15.00	20.00	Alluvium deposits, same in physical quality as above.

SARHAD DEVELOPMENT AUTHORITY
CORE DRILLING IN CLAY DEPOSITS
AT SHAMOZAI-BABUZAI AREA KATLANG

PROJECT: SURVEY AND EXPLORATION
OF LIMESTONE AND CLAY
DEPOSITS FOR BASING
CEMENT PLANTS IN NWFP.

HOLE NO. SC - 3

CORE SIZE - PX

TOTAL BORE DEPTH

20 M

CORE RECOVERY

20 M

PERCENTAGE OF CORE
RECOVERY

100 %

DATE: NOVEMBER, 96

LOGGED BY:

SELC PROJECT, SDA

FORM (M)	TO (M)	DESCRIPTION
0.00	17.00	Clay is silty along with minor lenses of argillaceous Clay along with calcitic gravels.
17.00	20.00	Silty Clay with calcitic gravels.

SARHAD DEVELOPMENT AUTHORITY
CORE DRILLING IN CLAY DEPOSITS
AT SHAMOZAI-BABUZAI AREA KATLANG

PROJECT: SURVEY AND EXPLORATION
OF LIMESTONE AND CLAY
DEPOSITS FOR BASING
CEMENT PLANTS IN NWFP.

HOLE NO. SC - 4

CORE SIZE - PX

TOTAL BORE DEPTH

20 M

CORE RECOVERY

20 M

PERCENTAGE OF CORE
RECOVERY

100 %

DATE: NOVEMBER, 96

LOGGED BY:

SELC PROJECT, SDA

FORM (M)	TO (M)	DESCRIPTION
0.00	17.00	Silty Clay, fine grained, compact alluvium deposits along with calcitic gravels
17.00	20.00	Silty Clay along with gravels.

SARHAD DEVELOPMENT AUTHORITY
CORE DRILLING IN CLAY DEPOSITS
AT SHAMOZAI - BABUZAI AREA KATLANG

PROJECT: SURVEY AND EXPLORATION OF LIMESTONE AND CLAY DEPOSITS FOR BASING CEMENT PLANTS IN NWFP.	HOLE NO. SC - 5
	CORE SIZE - PX

TOTAL BORE DEPTH 15 M	CORE RECOVERY 15 M	PERCENTAGE OF CORE RECOVERY 100 %
--------------------------	-----------------------	--------------------------------------

DATE: NOVEMBER, 96	LOGGED BY:	SELCT PROJECT, SDA
--------------------	------------	--------------------

FROM (M)	TO (M)	DESCRIPTION
0.00	15.00	Loss, silty Clay, fine grained, compact along with calcitic gravels. The same strata remains continued.

SARHAD DEVELOPMENT AUTHORITY
 CORE DRILLING IN CLAY DEPOSITS
 AT SHAMUZAI-BABUZAI AREA KATLANG

PROJECT: SURVEY AND EXPLORATION
 OF LIMESTONE AND CLAY
 DEPOSITS FOR BASING
 CEMENT PLANTS IN NWFP.

HOLE NO. SC - 6

CORE SIZE - PX

TOTAL BORE DEPTH
 17 M

CORE RECOVERY
 17 M

PERCENTAGE OF CORE
 RECOVERY
 100 %

DATE: NOVEMBER, 96 LOGGED BY: SELC PROJECT, SDA

FROM (M)	TO (M)	DESCRIPTION
0.00	7.00	Fine to medium grained compact Clay deposits along with gravels of carbonate and cemented material.

**SARHAD DEVELOPMENT AUTHORITY
CORE DRILLING IN CLAY DEPOSITS
AT SHAMOZAI-BABUZAI AREA KATLANG**

**PROJECT: SURVEY AND EXPLORATION
OF LIMESTONE AND CLAY
DEPOSITS FOR BASING
CEMENT PLANTS IN NWFP.**

HOLE NO. SC - 7

CORE SIZE - PX

TOTAL BORE DEPTH

20 M

CORE RECOVERY

20 M

**PERCENTAGE OF CORE
RECOVERY**

100 %

DATE: NOVEMBER, 96

LOGGED BY:

SELC PROJECT, SDA

FORM (M)	TO (M)	DESCRIPTION
0.00	17.00	Sandy Clay, compact, fine grained, soapy. Gravels of calcarreous material observed during core drilling.
17.00	20.00	Silty Clay along with calcarreous gravels.

SARHAD DEVELOPMENT AUTHORITY
CORE DRILLING IN CLAY DEPOSITS
AT SHAMOZAI-BABUZAI AREA KATLANG

PROJECT: SURVEY AND EXPLORATION
OF LIMESTONE AND CLAY
DEPOSITS FOR BASING
CEMENT PLANTS IN NWFP.

HOLE NO. SC - 8

CORE SIZE - PX

TOTAL BORE DEPTH

18 M

CORE RECOVERY

18 M

PERCENTAGE OF CORE
RECOVERY

100 %

DATE: NOVEMBER, 96

LOGGED BY:

SELC PROJECT, SDA

FROM (M)	TO (M)	DESCRIPTION
0.00	17.00	Silty Clay deposits, fine grained compact along with calcareous lenses.
17.00	20.00	Sandy Clay, continued as above.

2.12 RAW MIX DESIGN AND BURNABILITY TEST STUDIES OF LIMESTONE AND CLAY DEPOSITS AT SHAMOZAI-BABUZAI AREA KATLANG DISTRICT, MARDAN.

The Raw Mix design and burnability studies of the Limestone and Clay deposits at Shamozaibabuzai area Katlang District, Mardan were carried out by the Mineral Processing section of Mineral Testing Laboratory, SDA Peshawar.

For the said studies 5 Nos Limestone sample of 200 kg weight each and 5 Nos clay samples of 30kg each were provided to Mineral Testing Laboratory SDA.

A good quality clinker product suitable for cement manufacturing was produced by burning temperature of 1260°C at grain size 106 Micron 55% passing of 25 minutes grinding at SiO₂ ratio (SR) 3.15% Alumina Ratio AR 2.99% and Lime saturation (LS) 87.26 at Ratio Mix of Limestone 59.00% and clay 40.30%.

Through the aforementioned studies it is clear that the physical calculation of the ratio mix design and also the Lime saturation ratio, silica ratio and Alumina Ratio are feasible parameters for installation of a cement plant on these deposits.

A detailed Burnability and Raw Mix design Laboratory test studies report has been prepared by the Mineral Processing section of Mineral Testing Laboratory, SDA.

2.13 **INFRASTRUCTURE**

The area is plain and has a net work of metalled roads and jeep able paths. The Limestone deposits are easily approachable from Mardan via Katlang.

Katlang is a prominent village in the area and is located at a distance of about 20 Km in the North East direction from Mardan.

The area is drained by the canals of Swat river and plenty of water is available in the area.

Besides the above mentioned facilities, an adequate amount of electric power is also available in the area.

The Limestone and Clay deposits at Shamozaï-Babuzai area Katlang, Mardan were studied Geologically in detail. Geological and Contour Maps of these deposits were prepared on different scales.

These deposits were sampled core and auger drilling both in Limestone and Clay deposits were carried out. All the chips/rock and core samples were analyzed for CaO, MgO, SiO₂, Al₂O₃, Fe₂O₃, SO₃, K₂O, Na₂O Cl and L.O.I.

The analysis results are encouraging and are of cement grade. The Reserves of Limestone deposits at Shamozaï/Babuzai were calculated to a tune of 103.5 m.m.t in proved category, which can run a cement plant for more than 200 years with a capacity of 3000 T.P.D.

Moreover good quality with sufficient quantity of clay deposits are available near to the Limestone deposits.

The water which is an important component is available and the water table in the area is also present at shallow depth under the ground. The area is also connected through a series of metalled and unmetalled roads.

As the population is not dense and scarce so the environmental effects in the area by cement plant shall not be high.

The Shamozaibabuzai area is located in settled area of District Mardan so there would be no problem in acquisition of the land for installation of a cement plant in the area.

Keeping in view the above mentioned established parameters, it is recommended that a cement plant of 3000 T.P.D can be installed in the area. Which shall have a life more than 200 years. As the area is backward so this would be helpful in the development of the area and shall provide job opportunities to the local as well as shall pay revenue to the Govt in the form of Royalty, Excise and other taxes.

As no cement plant has been installed in the Northern part of NWFP, therefore the cement plant at Shamozaï-Babuzai area Katlang shall feed the Northern Districts of NWFP.

**LIMESTONE AND CLAY DEPOSITS
BANDA CHASHMA, KIRRI KHISOR
AND KOTLA LUDIAN AREAS
DISTRICT D.I.KHAN
N.W.F.P.**

3. BANDA CHASHMA KIRRI KHISOR AND KOTLA LODIAN AREAS
DISTRICT D.I.KHAN N.W.F.P

3.1 LOCATION AND ACCESSIBILITY.

The Limestone deposits at Banda Chashma, Kirri Khisor and Kotla Lodian areas are located on Survey of Pakistan Toposheet No. 38P/7 and 38P/16. Location maps of Banda Chashma Kirri Khisor and Kotla Lodian areas have been prepared on scale 1=50,000 (Fig-3.1a & 3.1c).

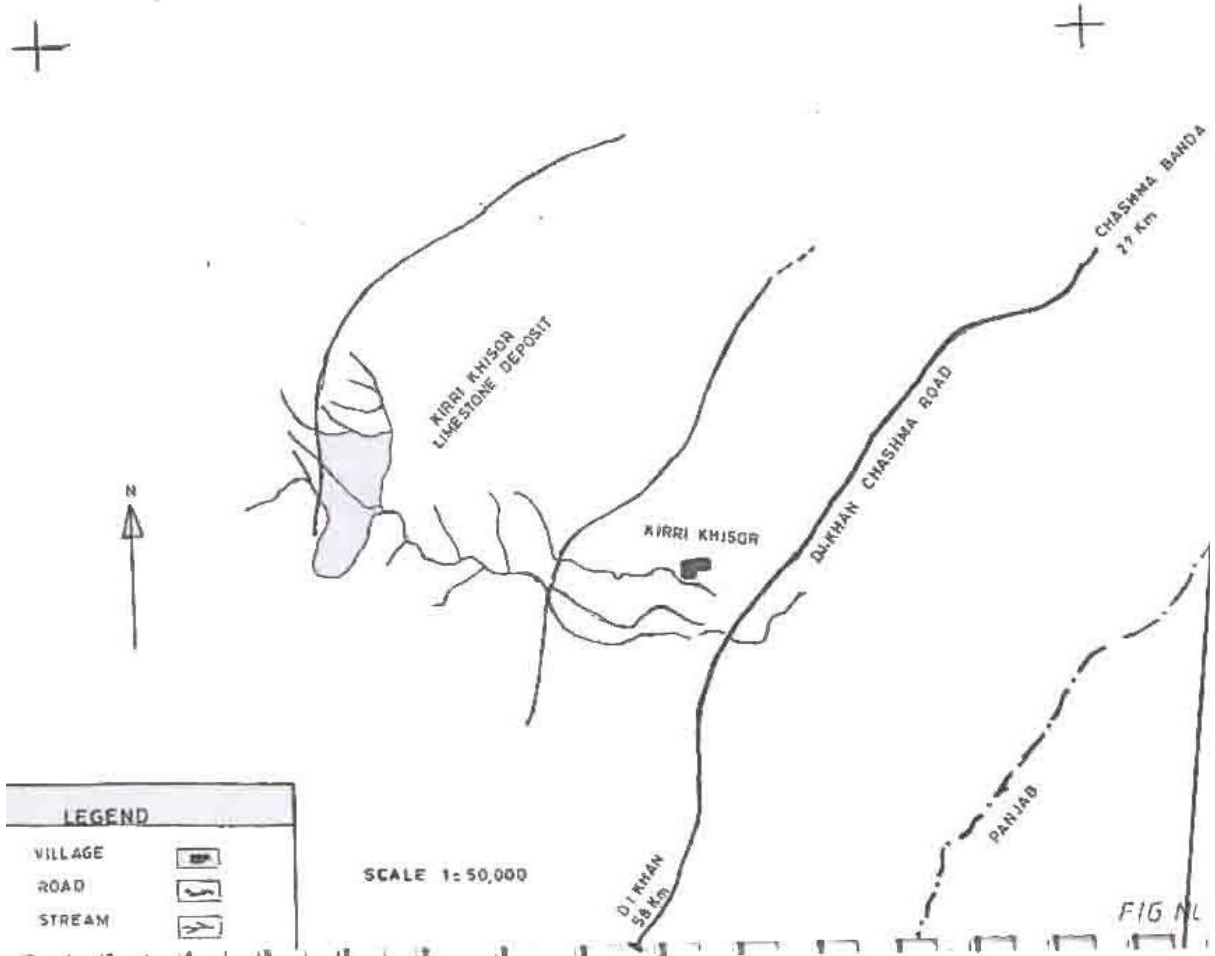
The Limestone deposits at Banda Chashma Kirri Khisor and Kotla Lodian areas are striking in East West direction while the Limestone deposits at Kirri Khisor and Kotla Lodian area are the West ward extension of the Banda Chashma Limestone deposits.

At a distance of about 50 k.m from kirri Khisor sizeable clay deposits are present near Band Korai village. A Location map of Band Korai area is prepared on scale 1:50,000 (Fig 3.1c).

Banda Chashma village is located at a distance of 90 km in the West direction of D.I. Khan while Kirri Khisor village is located in the North East direction at a distance of 56 kilometers from D.I.Khan.

Kotla Lodian area is located at a distance of 50 Km from D.I.Khan in the North East direction and Band Korrai village is located at a distance of 50 km in the West of Kirri Khisor area.

LOCATION MAP OF LIMESTONE DEPOSITS
AT KIRRI KHISOR AREA, D.I. KHAN.



3.2 TOPOGRAPHY AND CLIMATE

Topographically all the areas can be classified as the Western low lying areas which are almost plain.

These areas climatically falls in the region of sub tropical continental low land of climate.

The summer is hot and winter is cold and dry. The hottest months are June to August while the coldest months are December to February. In Summer the temperature ranges from 40 C° to 46 C°.

The Khisor and Marwat ranges are underlain by a thick sedimentary sequence of rocks, which are ranging from Cambrian to Quaternary in age. In the mapped area sedimentary rocks are Limestone, sandstone, siltstone, shale, clay, silica sand, dolomite and gypsum. General trend of these rocks are East West while dipping towards North. The accumulative thickness of Khisor and Marwat range is more than 7 kilometers, and are continuing from trans-Indus salt range. The stratigraphic sequence is encountered in a similar way, however with a difference from trans-Indus salt range on the basis of a complete absence of Eocene age sequence in Marwat and Khisor ranges. In mapped areas Siwalik rocks laying, unconformably over Jurassic rocks.

The rocks of Khisor and Marwat ranges are highly folded, making a synclinal structure with a few faults, especially in Khisor range. At Sheikh Baddin area Samana Suk Limestone is more than 120 m thick, form ridges with steep gradients. At Lutsar, the Samana Suk Limestone turns into a dome type structure with a total strike length of 6.5 kilometers. The hanging contact of this formation with the Chichali formation is unconformable while foot contact with Datta formation is confirmable. In Khisor range Samana Suk Limestone is absent towards south of Bud Banda. The underlying Datta formation is composed of various colors sandstone, silt stone, gypsiferous shale and clay. In Marwat range it is missing towards south of Sheikh Baddin and also have a limited extension in Khisor range near Paniala upto Bud Banda. Few lenses have also been observed at the southern end of Khisor range near Chashma area. The pure silica sand at the basal part is a distinctive feature of Datta formation. The Hanging contact of Datta formation with Samana Suk Limestone is confirmable, while the foot wall contact of this formation with Kingriali dolomite is unconformable.

The Kingriali dolomite is limited in Marwat range however at Khisor range it forms high peaks, extending from Paniala to East of Bud Banda. The Gypsum deposits have been observed near Sydowali and Sura Khel area in Khisor range. The hanging contact of Gypsum deposits is with yellowish color fine grained to medium grained sandstone and boulders, while the foot contact is with dolomitic Limestone.

General trend of these rocks are East-West while dipping toward North. The accumulative thickness of Khisor and Marwat range is more than 7 km and are continuing.

3.4 LOCAL GEOLOGY

The rocks in the investigated areas belong to Khisor range in trans Indus area. These rocks are mainly composed of sedimentary rocks of marine and non marine origin in nature ranging in age from permian to quaternary.

The Limestone deposits of the investigated areas belong to Zaluch group, which consists of Amb, Wargal and Chidru formation of late Permian age. The youngest deposits are Siwaliks of Quaternary age.

The Limestone is brownish grey to yellowish grey, rusty in color, fine grained, compact, jointed, highly fractured and medium to thick bedded. The upper part of the Limestone deposit is argillaceous and rich in Brachiopod fossils. During survey lenses of chert and dolomitic Limestone were observed which are distributed irregular in the investigated areas. In the middle portion of Limestone, chert lenses are deposited along the bedding.

3.5 STRUCTURAL GEOLOGY

The Khisor and Marwat ranges are characterized by a series of Anticlines, Synclines, Isoclinal folds, Thrust faults and Strike Slip faults.

In Marwat range two major East-West trending and plunging anticlines have been observed near Chunda and Lutsar area. The Silica Sand deposits are exposed on Northern flank of this anticline in Wazir Wah stream.

In Khisor range South of Paniala an anticline trending EW has been observed, and the silica sand and fire clay deposits are exposed on both limbs of this anticline. The eastern side of the anticline is converted into a synclinal structure, preserving silica sand bed in its core. The best exposures of this synclinal structure can be seen in Goritang Wan South East of Paniala town. Another anticline has been observed near Kotla Lodian area with a North South trend in Limestone deposit.

An Anticline is also observed near Chashma Banda village plunging to the North.

The Limestone deposits at Banda Chashma and Kirri Khisor and Kotla Lodian areas and the Clay deposits at Band Korai area D.I.Khan were sampled and a total of 74 Nos chip/rock samples were collected from the Limestone deposits at Banda Chashma and Kirri Khisor areas while 24 Nos of Clay samples were collected from the Clay deposits near Band Korai village D.I.Khan.

These samples were chemically analyzed for CaO, MgO, SiO₂, Fe₂O₃, Al₂O₃, K₂O, Na₂O, Cl, SO₃ and L.O.I. The analysis results are shown in the following table (Table No.3.1 and 3.2).

Table No 3.1

**ANALYSIS RESULTS OF CHIP AND ROCK SAMPLES
COLLECTED FROM THE LIMESTONE DEPOSITS AT
BANDA CHASHMA, KIRRI KHISOR & KOTLA LODIAN AREAS D.I.KHAN**

S.NO.:	SAMPLE NO:	CaO	MgO	SiO ₂	Fe ₂ O ₃	Al ₂ O ₃	K ₂ O	Na ₂ O	Cl	SO ₃	L.O.I
:	:	%	%	%	%	%	%	%	%	%	%
1.	LS- 103	50.84	0.66	4.80	0.25	0.37	0.09	0.10	0.17	0.21	42.19
2.	LS- 104	53.43	0.58	1.40	0.21	0.88	0.06	0.13	0.21	0.15	42.50
3.	LS- 105	38.08	1.49	1.48	0.07	0.42	0.04	0.08	0.21	0.30	23.16
4.	LS- 106	51.74	0.66	0.08	0.21	0.84	0.04	0.17	0.17	0.23	42.93
5.	LS- 107	52.20	0.49	3.30	0.11	0.11	0.02	0.12	0.17	0.20	42.55
6.	LS- 108	50.62	0.56	3.96	0.57	0.56	0.09	0.12	0.17	0.21	42.94
7.	LS- 109	50.28	0.58	2.86	0.20	0.56	0.04	0.39	0.21	0.35	42.00
8.	LS- 110	50.00	0.66	2.98	0.20	0.84	0.07	0.39	0.21	0.40	42.10
9.	LS- 111	53.08	0.56	1.54	0.11	0.42	0.04	0.10	0.17	0.15	43.00
10.	LS- 112	52.07	0.66	1.86	0.21	0.56	0.05	0.10	0.21	0.18	43.27
11.	LS- 113	49.28	0.61	5.30	0.08	0.75	0.02	0.11	0.24	0.30	42.66
12.	LS- 114	49.50	0.61	3.56	0.27	0.84	0.07	0.14	0.21	0.28	42.80
13.	LS- 115	51.07	0.59	2.00	0.18	0.75	0.04	0.11	0.21	0.21	43.79
14.	LS- 116	51.52	0.49	2.30	0.20	0.75	0.06	0.33	0.14	0.20	42.95
15.	LS- 117	50.17	0.58	3.92	0.17	0.23	0.06	0.36	0.17	0.28	42.90
16.	LS- 118	52.20	0.49	1.66	0.15	0.42	0.04	0.40	0.21	0.15	43.20
17.	LS- 119	51.96	0.49	3.20	0.14	0.08	0.03	0.11	0.24	0.16	43.20
18.	LS- 120	47.48	0.49	5.26	0.17	0.28	0.04	0.14	0.21	0.50	41.89

S.NO. : SAMPLE NO :	CaO	MgO	SiO2	Fe2O3	Al2O3	K2O	Na2O	Cl	SO3	L.O.I
:	%	%	%	%	%	%	%	%	%	%
19 : LSD- 264 :	53.50	0.66	0.52	0.18	2.02	0.20	0.020	0.14	0.10	42.00
20 : LSD- 265 :	53.50	0.82	0.54	0.22	1.08	0.20	0.020	0.15	0.10	42.58
21 : LSD- 266 :	52.61	0.82	0.58	0.20	2.70	0.18	0.030	0.13	0.11	42.12
22 : LSD- 267 :	52.64	0.74	0.60	0.18	2.00	0.21	0.030	0.11	0.14	43.01
23 : LSD- 268 :	51.52	0.96	0.89	0.14	1.88	0.22	0.030	0.20	0.13	43.15
24 : LSD- 269 :	54.00	0.50	0.40	0.15	1.72	0.18	0.010	0.13	0.10	42.67
25 : LSD- 270 :	53.08	0.82	0.81	0.12	1.68	0.18	0.010	0.12	0.12	42.55
26 : LSD- 271 :	52.65	0.82	0.55	0.14	2.20	0.20	0.020	0.14	0.11	43.00
27 : LSD- 272 :	52.60	0.66	0.91	0.14	0.32	0.18	0.020	0.12	0.11	43.00
28 : LSD- 273 :	50.17	0.79	0.78	0.22	2.12	0.21	0.020	0.14	0.13	43.27
29 : LSD- 274 :	52.28	0.49	0.92	0.12	0.28	0.20	0.020	0.11	0.12	43.46
30 : LSD- 275 :	53.48	0.66	0.77	0.20	1.40	0.18	0.020	0.10	0.11	42.68
31 : LSD- 276 :	52.00	0.66	0.44	0.21	1.76	0.18	0.030	0.12	0.10	43.00
32 : LSD- 277 :	51.04	0.71	0.98	0.20	1.72	0.21	0.030	0.10	0.10	43.38
33 : LSD- 278 :	51.52	0.66	0.75	0.25	4.66	0.20	0.030	0.26	0.24	41.12
34 : LSD- 279 :	50.28	0.49	0.79	0.12	3.26	0.22	0.030	0.12	0.13	43.83
35 : LSD- 280 :	50.84	0.74	0.73	0.14	2.26	0.20	0.020	0.13	0.12	42.86
36 : LSD- 299 :	43.23	0.71	1.14	0.25	14.58	0.24	0.040	0.19	0.15	38.31
37 : LSD- 300 :	51.52	0.63	0.88	0.14	2.36	0.16	0.020	0.13	0.11	42.77
38 : LSD- 301 :	52.28	0.65	0.92	0.08	0.72	0.18	0.020	0.12	0.10	42.25
39 : LSD- 302 :	52.65	0.49	0.74	0.14	2.92	0.18	0.020	0.11	0.10	41.99
40 : LSD- 303 :	52.28	0.66	0.90	0.11	0.84	0.20	0.010	0.12	0.11	42.49
41 : LSD- 304 :	54.88	0.59	0.42	0.12	0.58	0.17	0.010	0.12	0.10	42.65
42 : LSD- 305 :	50.24	0.58	0.72	0.14	4.96	0.17	0.020	0.10	0.10	42.44
43 : LSD- 306 :	51.44	0.56	1.79	0.12	0.96	0.17	0.010	0.11	0.12	42.45
44 : LSD- 307 :	52.56	0.63	1.50	0.14	1.40	0.20	0.010	0.10	0.10	43.00
45 : LSD- 308 :	50.80	0.66	1.50	0.20	1.40	0.22	0.020	0.11	0.11	43.36
46 : LSD- 309 :	51.92	0.66	1.65	0.25	2.20	0.18	0.020	0.12	0.12	42.68
47 : LSD- 310 :	51.52	0.82	0.89	0.28	3.86	0.14	0.420	0.11	0.11	41.07
48 : LSD- 311 :	52.41	0.66	0.87	0.17	2.14	0.09	0.060	0.12	0.12	42.13
49 : LSBK 281 :	51.52	0.66	0.88	0.15	3.36	0.09	0.020	0.30	0.30	42.13
50 : LSBK 282 :	52.64	0.58	0.56	0.12	2.00	0.09	0.010	0.10	0.10	43.42
51 : LSBK 283 :	51.29	0.49	0.87	0.15	2.42	0.09	0.110	0.12	0.12	43.29
52 : LSBK 284 :	51.96	0.49	0.88	0.11	2.28	0.07	0.070	0.11	0.11	43.08
53 : LSBK 285 :	51.40	0.33	0.88	0.10	1.94	0.07	0.020	0.12	0.12	43.21
54 : LSBK 286 :	51.52	0.54	0.86	0.17	2.50	0.07	0.030	0.10	0.10	42.88
55 : LSBK 287 :	50.24	0.46	1.18	0.08	2.06	0.06	0.020	0.12	0.12	43.36
56 : LSBK 288 :	46.36	0.66	1.14	0.42	11.48	0.10	0.090	0.34	0.34	39.20
57 : LSBK 289 :	51.72	0.49	1.00	0.10	2.94	0.07	0.150	0.12	0.12	42.90
58 : LSBK 290 :	51.95	0.44	1.02	0.08	2.40	0.06	0.030	0.19	0.19	42.90
59 : LSBK 291 :	35.16	1.98	1.28	0.50	28.42	0.12	0.070	0.35	0.35	31.75
60 : LSBK 292 :	6.72	0.66	2.24	3.28	80.50	0.08	0.090	0.30	0.30	5.12
61 : LSBK 293 :	50.84	0.33	0.88	0.05	1.60	0.06	0.030	0.12	0.12	42.74
62 : LSBK 294 :	45.69	0.33	1.16	0.47	13.66	0.07	0.110	0.12	0.12	37.36

S.NO.:	SAMPLE NO:	CaO	MgO	SiO2	Fe2O3	Al2O3	K2O	Na2O	Cl	SO3	L.O.I
:	:	%	%	%	%	%	%	%	%	%	%
63	LSBK 295	52.64	0.33	0.86	0.41	5.84	0.06	0.100	0.18	0.18	37.75
64	LSBK 296	47.04	0.31	1.12	0.52	12.00	0.07	0.310	0.13	0.13	37.54
65	LSBK 297	46.36	0.26	1.10	0.41	8.46	0.06	0.110	0.14	0.14	39.82
66	LSBK 298	53.76	0.29	0.84	0.11	0.72	0.05	0.009	0.18	0.18	43.45
67	LSBK 312	53.08	0.54	0.82	0.12	2.06	0.05	0.013	0.17	0.17	41.89
68	LSBK 313	53.31	0.44	0.83	0.08	1.50	0.05	0.004	0.16	0.16	43.14
69	LSBK 314	52.84	0.29	0.88	0.07	0.86	0.05	0.008	0.15	0.15	43.40
70	LSBK 315	46.14	1.49	1.14	0.57	7.40	0.06	0.009	0.11	0.11	40.72
71	LSBK 316	52.96	0.24	0.87	0.05	1.22	0.04	0.004	0.18	0.18	43.08
72	LSBK 317	52.28	0.33	0.88	0.02	2.08	0.04	0.004	0.11	0.11	42.74
73	LSBK 318	54.10	0.33	0.59	0.07	1.20	0.04	0.007	0.14	0.14	42.94
74	LSBK 319	52.48	0.29	1.11	0.05	1.48	0.04	0.012	0.12	0.12	42.91

-(64):-

Thin sections of the samples (LS-103 to LS-120) were prepared. These sections have been studied under the microscope to find the exact type of Limestone and to identify the associated minerals. The microscopic study is also aided by staining test. Detail is as follows:

The rock studied are compositionally Limestone based on petrographic studies except sample No. LS-105 which is a silicate rock in composition and contains fair amount of dolomite also. The calcite is dominant in quantity along with some dolomite, quartz, muscovite, sericite, orthoclase and opaque minerals. These rocks are also fossiliferous in nature.

Mostly the calcite are fine grained, almost of microspar size. The cementing material is commonly sparite although unfilled pore-spaces remain in some cases. They are variable in size usually found in luster form, calcites are usually occur in the form of small veinlets, also of variable thicknesses. In some cases they are cross-cutting each other. Slightly curve veinlets are also not uncommon.

Partially recrystallized grains are also found, (LS-115), while thin section of sample No. LS-114 have recrystallized calcite grain which are slightly amorphous in nature. Ferroan calcite are dominant in most of the samples.

Thin sections of sample No. LS-104 & LS-106 are highly weathered due to which the ancient features are over shadowed as the carbonate rocks are quite susceptible to chemical weathering.

Quartz grains are smaller in size, with slight undulose extinction. The finer grains are also found in aggregate shape. Isolated & fresh grains are present in thin sections of sample No. LS-104 & LS-106, while the thin section of sample No. LS-108 is comparatively more rich in quartz. Some broken grains are also present.

Muscovite is flaky, elongated & also slightly fibrous in nature. Secricite grains are also common.

The studied Limestone samples are highly fossiliferous due to which various features are also observed. The neomorphism refer to all transformations between a mineral & the same mineral, or an other mineral of the same general composition. The terms microspar and pseudospar are used for crystal mosaic of neomorphic origin having a mean size of between 4 & 10 um and >10 um respectively.

The Bryozoans (bioclast) are circular, concentrically laminated grains, and the thick calcite wall of the bryozoans & on the pores of different sizes with in the skeleton, filled with pink satin non-ferroan calcite cement.

A boundstone is a Limestone in which sediment is bound together by organisms, such as occurs in many reefs. In the thin section, the Limestone comprising growth of numerous problematic organism which have encrusted one another while incorporating fine grained sediments in to the rock frame work, (LS-104 & LS-106).

Allochemes other than bioclast may become micrimitized, shows a number f grains with varying degrees of preservation of radial & concentric ooide textures, (LS-116 & LS-117). It is possible that the texture was partially lost by micrimitization, although it might also have been lost during inversion of an original aragonite ooide to calcite. The ooids also illustrate a rather poorly preserved concentric structure. The structure may have been partly lost by micrimitization.

Thin sections of 18 Nos rock samples (LS-103 to LS-120) were prepared. These sections have been studied under the microscope to find the exact type of Limestone partly lost by micrimitization.

3.8 RESERVES OF LIMESTONE DEPOSITS AT BANDA CHASHMA, KIRRI
KHISOR AND KOTLA LODIAN AREAS D.I.KHAN.

A. RESERVES OF LIMESTONE DEPOSITS AT BANDA CHASHAMA KIRRI
KHISOR AREA D.I.KHAN

The reserves of the Limestone deposits at Banda Chashma Kirri Khisor area D.I.Khan were calculated in inferred category to a tune of 151.2 m.m.tones with the following measurements.

Length	=	5400 m
Average Depth	=	200 m
Average Thickness	=	50 m
Sp. Gravity	=	2.8
Tonnage = 5400 x 200 x 50 x 2.8	=	151.2 m.m.t.

B RESERVE OF THE LIMESTONE DEPOSITS AT KOTLA LODIAN AREA
D.I.KHAN

Reserves of the Limestone deposits at Kotla Lodian area were calculated in inferred category to a tune of 56m.m.t.

These deposits are exposed on the surface, light gray in color fine to medium grained, highly fracture-dand jointed.

The following measurements were taken on average basis to calculate the Reserves.

Length	=	400 m
Average Depth	=	100 m
Average Thickness	=	50 m
Sp. Gravity	=	2.8
Tonnage = 400 x 100 x 50 x 2.8	=	56 m.m.t.

Thus the total inferred Reserves at Banda Chashma Kirri Khisor and Kotla Lodian areas are 207.2 m.m.tones.

3.9 CLAY DEPOSITS

Clay is one of the most important additives used in manufacturing of cement. Raw material used for manufacturing of portland cement should contain 70-75 % CaO and 20-25 % of Clay substance.

Sizeable deposits of clay are available near Band Korai village located on Survey of Pakistan Toposheet No. 38P/16 at a distance of about 50 km from Kirri Khisor area. 19 Nos clay samples were collected from these deposits, which were analyzed for CaO, MgO, SiO₂, Fe₂O₃, Al₂O₃, K₂O, Na₂O, Cl, SO₃ and L.O.I.

TABLE NO. 3.2

ANALYSIS RESULTS OF CLAY SAMPLES COLLECTED FROM THE CLAY DEPOSITS AT BAND KORAI AREA D.I.KHAN

S.NO.:	SAMPLE NO.:	CaO	MgO	SiO ₂	Fe ₂ O ₃	Al ₂ O ₃	K ₂ O	Na ₂ O	Cl	SO ₃	L.O.I
:	:	%	%	%	%	%	%	%	%	%	%
1	CL- 21	16.8	2.48	38.3	4.57	12.96	5.3	3.37	0.95	0.3	12.99
2	CL- 22	14.5	1.32	48	4	13.34	2.5	2.23	0.5	0.52	12.5
3	CL- 23	11	1.16	55	2.5	12.59	3.5	1.85	0.35	0.32	11.2
4	CL- 24	11	1.65	55	2.48	10.33	4.57	2.3	0.42	0.38	11.21
5	CLBK 49	19.92	2.15	9.30	3.71	38.60	4.04	2.280	0.22	0.24	18.05
6	CLBK 50	18.47	1.98	11.80	4.43	37.10	4.44	2.770	0.21	0.23	17.37
7	CLBK 51	9.03	0.66	14.80	6.72	46.80	3.90	3.610	0.18	0.21	12.30
8	CLBK 52	12.63	1.98	10.80	4.57	45.60	5.52	3.010	0.17	0.19	14.59
9	CLBK 53	10.13	0.49	15.20	6.29	46.00	3.36	3.610	0.16	0.22	12.67
10	CLBK 54	11.03	1.82	12.90	5.71	46.40	4.44	3.370	0.15	0.23	13.31
11	CLBK 55	12.13	1.65	13.80	5.14	46.20	3.36	2.890	0.17	0.25	12.81
12	CLBR 56	10.84	1.16	10.90	4.28	53.00	4.04	2.160	0.16	0.23	12.45
13	CLBR 57	12.61	1.16	10.50	4.28	53.00	2.69	1.800	0.14	0.22	12.43
14	CLBR 58	9.48	0.99	13.30	5.00	51.80	2.69	2.400	0.20	0.20	13.40
15	CLBR 59	9.48	1.32	12.90	4.28	50.60	4.31	3.130	0.21	0.19	13.38
16	CLBR 60	11.60	1.65	11.70	4.28	50.40	3.50	2.650	0.18	0.18	12.70
17	CLBR 61	11.16	1.49	11.70	4.28	50.60	3.09	2.520	0.16	0.16	13.01
18	CLBR 62	8.96	1.49	10.90	3.57	57.80	2.96	2.040	0.14	0.19	11.55
19	CLBR 63	8.96	1.65	10.40	3.14	58.20	3.50	1.920	0.13	0.17	11.29

Handwritten note:
 All 19
 Contact is
 high

3.10 **INFRASTRUCTURE.**

The Banda Chashma area is connected through a metalled road with D.I.Khan at a distance of about 90 Km in South West direction and at a distance of 25 Km in the South East direction with Kundian railway station district Mianwali. Aplenty of Indus river water is available near the Limestone deposits. An electric power station is under construction at Chashma barrage.

The Kirri Khisor and Kotla Lodian areas are connected through a metalled road with D.I.Khan. D.I.Khan is located at a distance of about 90 Km in the North East direction. A plenty of sub soil water is available in the area.

The Kirri Khisor area is located in the North East direction of D.I.Khan at a distance of 90 Km and is connected with D.I.Khan through a metalled road and Kotla Lodian is located at 50 Km distance from D.I.Khan.

A plenty of sub soil water is available in the area.

The Limestone deposits at Banda Chashma Kirri Khisor and Kotla Lodian areas D.I.Khan were sampled and a total of 74 Nos of chip/rock samples from Limestone deposits of both the areas were collected.

These samples were analyzed at Mineral Testing Laboratory, S.D.A Peshawar for CaO , MgO , SiO_2 , Al_2O_3 , Fe_2O_3 , K_2O , Cl and L.O.I.

The chemical analysis results of these samples are showing high content of CaO and low MgO content, which reveals that these deposits are suitable for cement grade.

The inferred reserves of the Limestone deposits at Banda Chashma Kirri Khisor and Kotla Lodian areas were calculated to a tune of 207.2 m.m.tones.

There is no suitable clay/shale available in the near by vicinity of Banda Chashma area therefore the Clay deposits at Bandkurai can be used.

To study the area in more detail a detailed geological exploration, comprising geological mapping, sampling and core drilling of the Limestone deposits at Banda Chashma Kirri Khisor and Kotla Lodian areas and clay deposits of Bandkorai area D.I.Khan should be carried out.

**LIMESTONE AND CLAY DEPOSITS
AT PALAI AREA
MALAKAND
N.W.F.P.**

25

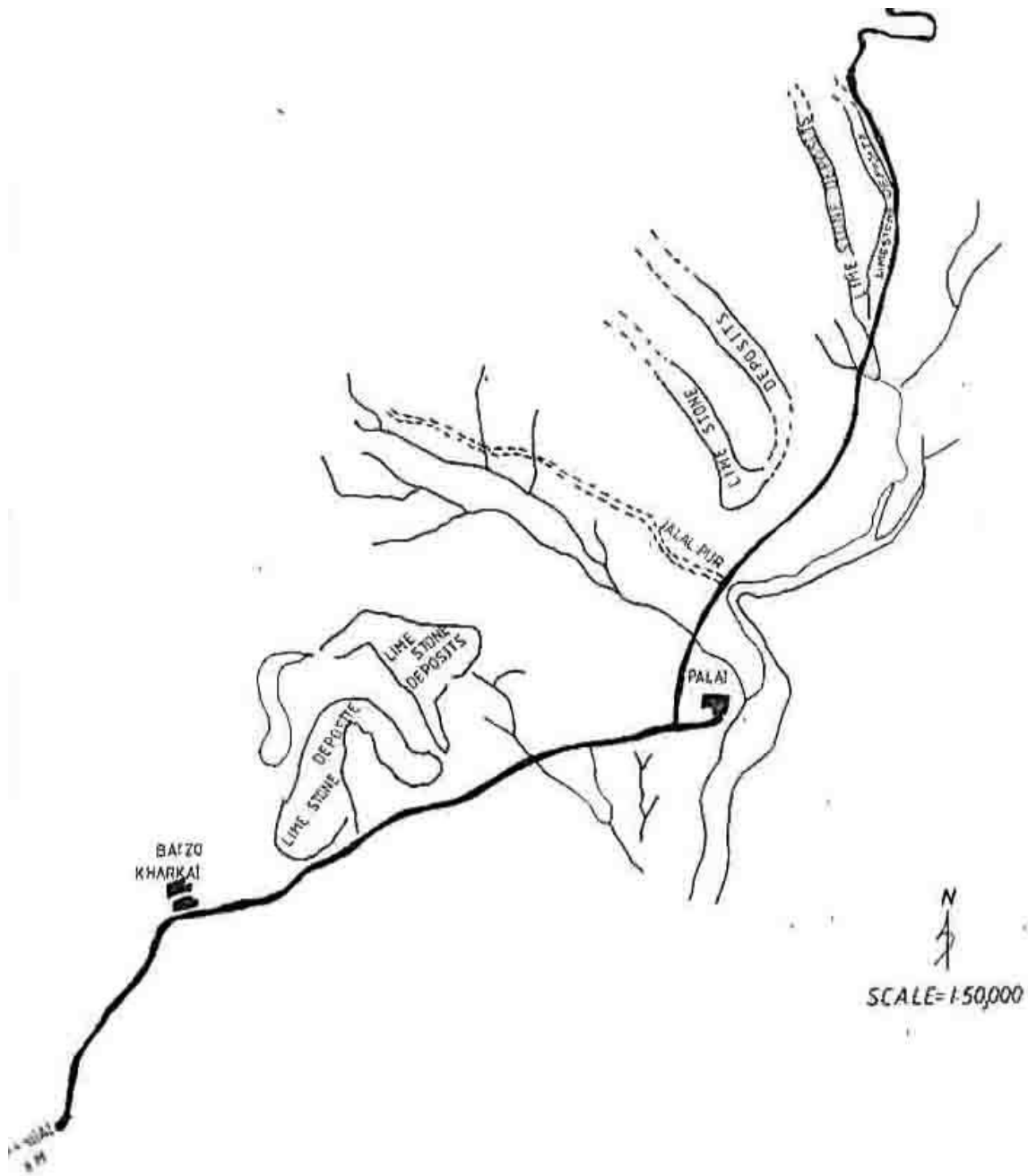
4.

PALAI AREA MALAKAND

4.1 LOCATION AND ACCESSIBILITY.

The Limestone and clay deposits of Palai area Malakand are located in Malakand Agency near Palai village on Survey of Pakistan Toposheets No.43 B/2 and 43 B/3 between Longitude $72^{\circ}-2'-0''$ to $72^{\circ}-5'-38''$ and Latitude $34^{\circ}-29'-30''$ to $34^{\circ}-34'-30''$.

Palai village is located at a distance of 20 Km in the North East direction of Dargai town. A metalled road is leading to Palai village from Dargai. Dargai is a prominent town and business center of Malakand Agency. Dargai is connected by railway line to the other parts of the country.



LOCATION MAP OF LIME STONE DEPOSITS AT BAIZO KHARKAI & PALAI AREA
DISTT. MARDAN

FIG NO: 4

4.2 — TOPOGRAPHY AND CLIMATE

The area is generally characterized by undulating topography with the hills of high peaks in the North direction. The highest peak in the area reaches upto 985 m.

The area in the North East direction of the Limestone deposits is covered with residual soil. The topography bears a definite relation to the lithology and structure of the rocks exposed in the area.

The area has a tropical climate i.e cold in winter and hot in summer. In summer the temperature ranges from 25°C to 45°C during the month of June and July.

The area receives poor rain fall. The maximum rain fall is during the moon soon season.

4.3 GENERAL GEOLOGY.

South Eastern part of the Lower Swat Bunair Schistose group. The Lower Swat Bunair Schistose group has been intruded by Swat granitic gneisses.

The Lower Swat Bunair Schistose group lies to the south of the Upper Swat Hornblendic group and covers most of the Lower Swat, Bunair and north east part of Mardan.

Martin et al divided the Lower Swat Bunair Schistose group in the following sub groups.

- (e). Green schists.
- (d). Phyllitic schists.
- (c). Marbles and calcareous schists.
- (b). Amphibolite Horizon.
- (a). Siliceous schists.

(a). SILICEOUS SCHISTS.

The siliceous schists are quartz-garnet-mica schists closely associated with the granitic gneisses and occasionally contain beds of amphibolite and crystalline marble.

(b). AMPHIBOLITE HORIZON

The amphibolites are dark green , having abundant hornblend with pale pink garnet ,epidote and little feldspar and quartz. The Amphibolite horizon is either underlain or overlain by the calcareous schists and marbles .

(c). **MARBLES AND CALCAREOUS SCHISTS.**

The marbles and calcareous schists show interbedding. They occur in Bunair, from where they extended to North into Chakesar area and South West upto Jamal garhi of Mardan district. The Marbles are coarsely crystalline but generally thinly bedded and contain thin layers of Mica and Garnet amphibolite.

The calcareous schists are rich in garnet and mica and they sometime show thin bands of quartzite. Coarse grained Kyanite is found in the formation.

(d). **PHYLLITIC SCHISTS.**

The phyllitic schists of the schistose group overly the Marbles and calcareous schists and grade into the overlying green schists, but the North Western part of the phyllitic schists pass into a zone of garnet mica schists. The phyllitic schists are dark grey and pelitic, with small amount of graphite, siderite, and limonite pseudomorphs.

(e). **GREEN SCHISTS.**

The green schists of the group include chlorite schists, epidote-albite schists, epidote-feldspar-quartz schists, epidote actinolite schists and magnetite-chlorite schists.

Shams(1980)described the Shangla blue schists and considered these to be a part of these green schists.

Regarding the age of rocks Bakr and Jackson (1964) put the schistose group in the lower paleozoic age and King (1961) put the carbonate rocks of the schistose group in upper paleozoic.

Apart from these units, Martin et al (1962), described some broken beds of serpentinites, highly altered basic intrusions and feldspathised chlorite schists near the contact with the

hornblendic group. The basic intrusions are oftenly associated with sheared schists and quartz-siderite-chlorite schists. Martin et al as well as Danies(1962) have described that the beryl(emerald), occur in the schists and also in associated quartz veins.

Jan(1980) have shown that the green schists including blue schists, serpentine, basic intrusions etc, constitute a high pressure metamorphic zone. He showed that this zone is not a part of the Lower Swat Bunair Schistose group and that this is a faulted block.

Martin et al described that the hornblendic group overrides the schistose group along a thrust contact. Recently Jan(1977a) and Tahirkheli et al (1979) considered this thrust to be the suggested western extension of Indus suture zone. Tahirkheli(1979) gave the name M.M.T. to this thrust fault.

Martin et al have described that the schistose group have been intruded by the Swat granitic gneisses. These gneisses have been emplaced as sheets of magma, the main sheet of which reaches a few thousand feet in thickness near Ilam. Jan and Tahirkheli (1969) have suggested that the schistose group during the earlier phases of himalayan orogeny (in middle to late cretaceous time) was intruded by ultramafic rocks(jijal ultramafics). Later on Jan(1977,79,80) included these ultramafics in the jijal complex of Kohistan island Arc. Jan and Tahirkheli(1969) have also described that during the later phases of himalayan orogeny (in early tertiary time),the schistose group was intruded by Swat granitic gneisses, granite, granodiorite gneisses, quartz veins and few amphibolite bearing rocks. On the other side Tahirkheli(1980) have mentioned that the Swat granitic gneisses is the oldest magmatic emanation of the Peshawar valley associated with the Gadoon fault of the pre - alpine orogenic episode. But still Tahirkheli et al (1979) have described that the schistose group was intruded by many granitic plutons and suggested that most of these granitic bodies are older than the main tectonics(Cretaceous - Tertiary Tectonics i.e. collision of Eurasian and Indo-Pakistan plates), while some were intruded during and after the main tectonics and metamorphic events.

Shams(1963a) described the production of skarns in the schistose group by the alteration of a calcareous xenolith with in the granite gneisses of Manglore area - Swat.

A general Geological map is prepared on scale 1:50,000.(Fig-4.1)

Describing the structure of the schistose group Martin et al have mentioned lineations, folds, drag folds and other intraformational deformations. The folds are syntectonic and they reflect two predominant directions; a north east ward and south west ward. The lineations are due to fold replies or cleavage fracture. Tahirkheli et al (1979) described that the Lower Swat Bunair schistose group under thrust against the Kohistan Island Arc along the M.M.T. They described that the Schistose Group consist of shales and mica schists, with some ortho-gneisses, amphibolites and marbles. The metamorphism of the rocks increase toward the M.M.T. Severe deformation of the rocks resulted in foliation, lineations and folds. They are of view that the foliation with a general south or north or north - north west dip direction is due to the intense deformation caused by the over thrusting of kohistan Island Arc during the collision of the Eurasian and Indo Pakistan plates in late Mesozoic or early Tertiary time. They supported the idea by the fact that the foliation in the kohistan sequence and Schistose Group is parallel to the M.M.T. This phase of deformation also produced north - south trending isoclinal folds.

The Lime Stone deposits of Palai area Malakand agency have the upper contact with the schists, while the lower contact is not exposed and covered by Alluvium. The Limestone is medium to thick bedded, striking in the North East direction, while dipping in South West direction. Isoclinal folds, Anticlines and Synclines can be observed at places. The Limestone is highly fractured and jointed. Different types of fractures and joints across the beds are present.

The Limestone deposits of Palai area occur within the cores of Synclines and Anticlines.

The rocks of the reported area are exposed in the Eastern part of the lower Swat Bunair Schistose group. The lower Swat Bunair Schistose group has been Intruded by Swat granitic gneisses.

The lower Swat Bunair Schistose group lies to the south of the upper Swat Hornblendic group and covers most of the lower Swat, Bunair and North East part of Mardan.

The lower Swat Bunair schistose group has been further divided by Martin et al in the following sub groups.

- e) Green schists
- d) Phyllitic schists
- c) Carbonates (Marbalized) and calcareous schists.
- b) Amphibolite Horizon.
- a) Siliceous schists.

The Limestone deposits of the area belong to carbonates (Marbalized) and calcareous schists.

The Limestone deposits of Palai area are exposed in between Palai and Baizo Kharakai villages in the North East of Dargai.

The main formations in the area are Limestone, Schists, and Alluvium. Schists are intruded by granitic gneisses in the North of Palai Village. The Schists are folded forming Synclinal and Anticlinal structures. The Limestone is found in the cores of these Structures.

The Limestone is fine to medium grained massive thick bedded, marbalized, highly fractured and jointed, grey in color.

The Limestone and clay deposits at Palai area Malakand Agency were sampled and total of 22 Nos chip/rock samples and 9 Nos of clay samples were collected and chemically analyzed for CaO, MgO, SiO₂, Fe₂O₃, Al₂O₃, K₂O, Na₂O, Cl, SO₃ and L.O.I.

The analysis results of most of the Limestone samples are showing high CaO content and low content of MgO. The analysis results of the clay samples are also favorable for cement manufacturing. Results are shown in the following table No.4.1

Table-4.1

**ANALYSIS RESULTS OF ROCK/CHIP SAMPLES
COLLECTED FROM THE LIMESTONE DEPOSITS
AT PALAI ARE MALAKAND**

Sr.NO.	SAMPLE NO.	CaO %	MgO %	SiO ₂ %	Fe ₂ O ₃ %	Al ₂ O ₃ %	K ₂ O %	Cl %	SO ₃ %	L.O.I %
1.	PLA-1	50.17	1.07	1.96	0.25	0.75	0.024	0.35	0.011	42.4
2.	PLA-2	50.24	2.00	2.50	0.18	1.10	0.018	0.34	0.011	43.00
3.	PLB-1	53.60	0.91	0.82	0.15	0.75	0.014	0.24	0.010	43.00
4.	PLB-2	50.40	0.33	2.48	0.07	0.73	0.016	0.24	0.012	43.23
5.	PLC-1	51.00	0.82	3.06	0.14	1.30	0.014	0.35	0.013	42.56
6.	PLC-2	52.86	0.73	1.88	0.17	0.56	0.010	0.32	0.120	42.85
7.	PLC-3	49.28	1.10	6.76	0.61	0.14	0.020	0.21	0.015	41.00
8.	PLC-4	49.72	1.29	1.98	0.31	0.12	0.015	0.28	0.014	43.72
9.	PLD-1	49.27	1.65	2.98	0.11	0.01	0.012	0.24	0.016	43.53
10.	PLD-5	49.70	0.49	5.50	0.12	0.14	0.012	0.17	0.018	52.14
11.	PLD-9	47.49	1.65	8.52	0.39	1.10	0.044	0.32	0.021	39.40
12.	PLD-12	49.50	1.16	7.94	0.28	0.23	0.020	0.24	0.017	40.23
13.	LSK- 175	53.76	1.16	0.70	0.28	0.01	0.02	0.24	0.06	42.71
14.	LSK- 176	51.52	1.32	1.20	0.42	0.59	0.02	0.10	0.07	42.76
15.	LSK- 177	52.64	1.38	1.29	0.34	0.46	0.02	0.17	0.05	42.00
16.	LSK- 178	51.07	1.82	2.00	0.37	0.56	0.02	0.21	0.08	42.36
17.	LSK- 179	53.20	0.82	1.12	0.40	0.46	0.02	0.14	0.05	42.00
18.	LSK- 180	54.88	0.32	0.50	0.24	0.75	0.19	0.21	0.04	42.11
19.	LSK- 181	50.62	1.09	2.46	0.31	0.78	0.02	0.17	0.08	43.24
20.	LSK- 182	50.40	0.95	2.42	0.37	0.80	0.02	0.21	0.07	43.31
21.	LSK- 183	51.52	0.99	2.92	0.42	0.56	0.02	0.17	0.10	42.56
22.	LSK- 185	50.84	0.80	4.20	0.28	0.51	0.02	0.15	0.09	42.49

Thin sections of samples Nos PLA-1, PLA2, PLB-1, PLB-2, PLC-1, PLC-2, PLC-3, PLC-4, PLD-1, PLD-5, PLD-9 and PLD-12 were prepared. These sections have been studied under the transmitted light microscope.

Description is as follows.

<u>S.No</u>	<u>Sample No.</u>	<u>Type</u>
1.	PLA -1	Recrystallized L.stone
2.	PLA -2	-do-
3.	PLB -1	Recrystallized Limestone(Marble)
4.	PLB -2	Partially Recrystallized L.stone
5.	PLC -1	-do-
6.	PLC -2	Recrystallized Limestone
7.	PLC -3	Partially Recrystallized L.stone
8.	PLC -4	Recrystallized Limestone
9.	PLD -1	-do-
10.	PLD -5	-do-
11.	PLD -9	-do-
12.	PLD -12	Partially Recrystallized L.stone

As shown above the following 2 main types of Limestones have been identified in these sections.

1. Partially Recrystallized Limestone.
2. Recrystallized Limestone

1. Partially re-crystallized Limestone shows micro-stylolites which provides channel ways for migration of solutions. These re-crystallized grains have ghost structure, Mollascfragments

and also echinoderms. Some calcite is replaced by dolomite while some calcite is recrystallized & forms comparatively big grains.

2. The recrystallized Limestone is mostly equigranular interlocking texture. Slight foliation and parallel alignment of crystals which are comparatively big grains is common. Mostly there is no cementing material present.

The quartz grains are mostly rounded to subrounded, spherical Mono-crystalline grains mostly trapped along the crystal boundaries.

Samples Nos PLC-1, PLD-9, and PLD-12 are more quartz rich. The quartz grains are anhedral in shape mostly in cluster form.

Clay is one of the most important additives used in manufacturing of portland cement. Clay is a fine grained earthy material which is a mixture of different minerals. Clay is a hydrated silicate with defined chemical composition and crystal structure.

Raw materials used for manufacture of portland cement should contain 70-75% of CaO, and 20-25% of clayey substance.

At the foot hills of the Limestone deposits in South East direction a flood plain of several km², is present containing huge deposits of very fine clay.

The chemical analysis results of the samples collected from these deposits(PC-1,PC-2,PC-3,PC-4) and 5 Nos samples collected from the Schists(CLK-34 -CLK-38) as shown in the following table No 4.2 reveals that the clay and Schists near Baizo Kharakai village are suitable for cement grade.

The thickness of the clay strata was confirmed through a dug well in the area which is about 15 m thick.

TABLE No.4.2

**ANALYSIS RESULTS OF CLAY SAMPLES COLLECTED FROM
CLAY AND SCHIST AT PALAI - KHARKAI AREA, MALAKAND**

S.NO.	SAMPLE NO.	CaO %	MgO %	Na2O%	SiO2 %	Fe2O3 %	Al2O3 %	K2O %	Cl %	SO3 %	L.O.I %
1.	PC-1	2.65	0.49	-	63.00	4.28	14.56	3.490	0.32	0.040	10.10
2.	PC-2	4.47	1.32	-	60.00	4.43	14.50	3.370	0.35	0.080	10.00
3.	PC-3	8.00	1.65	-	57.40	4.57	13.56	3.350	0.42	0.060	10.55
4.	PC-4	8.50	1.52	-	57.40	4.00	13.48	3.250	0.39	0.070	10.98
5.	CLK-34	8.80	1.65	0.64	57.40	4.71	12.70	1.68	0.52	0.34	11.07
6.	CLK-35	7.96	2.98	0.66	56.00	4.43	13.60	1.80	0.47	0.28	11.36
7.	CLK-36	7.39	3.81	0.68	57.40	4.28	11.50	1.80	0.34	0.17	11.79
8.	CLK-37	7.73	3.64	0.61	56.00	4.57	14.00	1.80	0.21	0.31	10.61
9.	CLK-38	8.73	2.48	0.57	53.30	4.14	12.20	1.68	0.33	0.34	15.62

4.9 **INFERRED RESERVES OF LIMESTONE DEPOSITS AT PALAI AREA
MALAKAND**

The Inferred reserves of the Limestone deposits at Palai area Malakand were calculated to a tune of 719.60 m.m.t.

As the Limestone deposits are being separated by Schists so to calculate the inferred reserves of these deposits, they are divided into four blocks (block A, block B, block C, block D).

Description of Inferred reserves of each block is as follows.

Block- A

Block A is located in the NW direction of Mora banda village near the main Dargai-palai road. The beds are striking in the NE direction while dipping in the SE direction.

For Inferred reserves calculation the following measurements were taken:

Strike length	=	1500 m.
Thickness	=	40 m.
Depth	=	150 m.
Sp.Gravity	=	2.8
Tonnage	=	$1500 \times 40 \times 150 \times 2.8 = 25.2 \text{ m.m.t.}$

BLOCK-B

Block B is located at a distance of 1km in the SW direction of block A separated by schists.

To calculate the inferred reserves of block B the following measurements were taken.

Strike length	=	1000 m.
Thickness	=	40 m.
Depth	=	200 m
Sp. Gravity.	=	2.8
tonnage = $1000 \times 40 \times 200 \times 2.8$	=	22.4 m.m.t.

BLOCK-C

Block C is located in the North West direction of palai village at a distance of about 4 km, near kharakai kandao.

To calculate the inferred reserves of Block C the following measurements were taken.

Strike length	=	1500 m.
Thickness	=	200 m.
Depth	=	500 m
Sp. Gravity	=	2.8
tonnage = $1500 \times 200 \times 500 \times 2.8$	=	420 m.m.t.

BLOCK-D

Block D comprises of the main Limestone deposits of palai area located near Baizo kharakai village, extended in the NE direction along the road for about 2 km distance.

These beds of Limestone are striking in the NE direction while dipping in the NW direction at places.

The following measurements were taken to calculate the inferred reserves of this block.

Strike length	=	2000 m.
Thickness	=	150 m.
Depth	=	300 m.
Sp.Gravity	=	2.8 m.
Tonnage = $2000 \times 150 \times 300 \times 2.8$	=	252 m.m.t

Total Inferred Reserves: $25.2 + 22.4 + 420 + 252 = 719.6$ m.m.t

The area is more or less plain and has a net work of metalled roads and jeepable paths.

The Lime stone and clay deposits are easily approachable from Dargai through a metalled road.

The water problem can be solved through tub wells. There are so many dug wells are present in the area, having water table at about 6m depth.

As the area is located near the Jaban Power house-Dargai, so there is no problem of electric power in the area.

4.11 CONCLUSION AND RECOMMENDATIONS

The Lime stone and clay deposits of Palai area Malakand were sampled and 22 Nos Rock samples were collected from the lime stone deposits at different locations. 04 Nos clay and 05 Nos Schist samples were collected from the clay and Schists deposits.

These samples were analyzed for CaO, MgO, SiO₂, Al₂O₃, Fe₂O₃, SO₃, K₂O, Cl and L.O.I.

The chemical analysis results of all the samples are showing high content of CaO, and low content of MgO which favors the suitability of these deposits for cement grade.

The Inferred reserves of these deposits have been calculated to a tune of 719.60 m.m/t which also favoring the installation of a cement plant in the area.

As the present study has not been carried out in detail and to assess the quality and quantity of the Lime stone and clay deposits of the area in more detail a detailed geological exploration of the Lime Stone and Clay deposits of Palai area Malakand comprising Geological mapping, sampling and core drilling, is required, to assess the quality as well as quantity of these deposits for installation a cement plant in the area.

**LIMESTONE AND CLAY DEPOSITS
AT TANGI AND SURROUNDING
AREAS
CHARSADDA
N.W.F.P.**

5. TANGI AND SURROUNDING AREAS DISTRICT-CHARSADDA

5.1. LOCATION AND ACCESSIBILITY

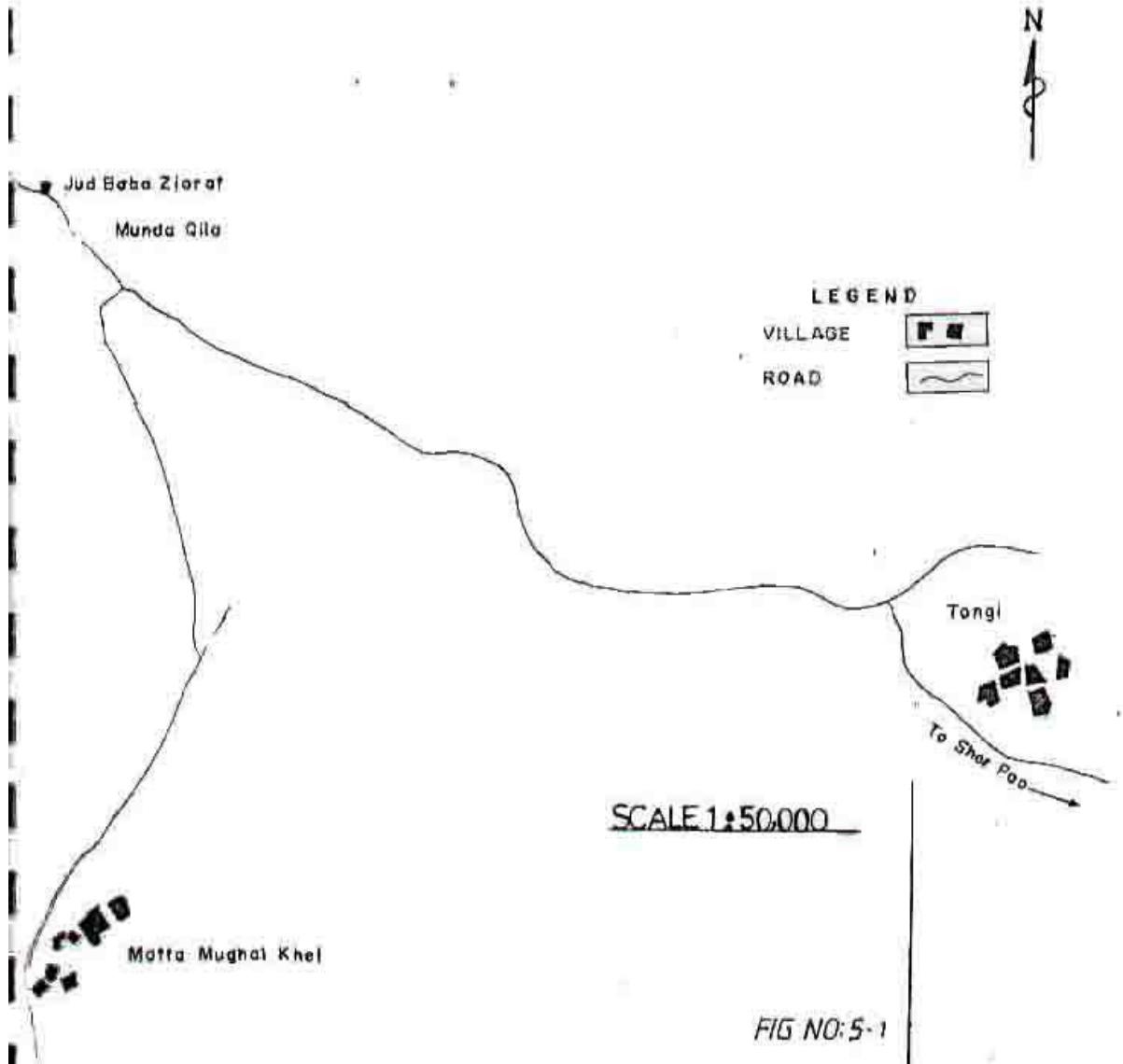
The Limestone and clay deposits of Tangi and surrounding areas are located on Survey of Pakistan Toposheet No. 38N/11 near Qaroon Dehri-Tangi and Jud Baba Ziarat Mohmand Agency.

A location map of the area is prepared on scale 1=50,000 (fig 5.1).

The Tangi area is almost plain and a few hillocks of the Limestone (dolomitic) are present near Qaroon Dehri village. The area of Jud Baba Ziarat has a rugged topography with high mountains.

The climate of the area is subtropical.

LOCATION MAP OF LIMESTONE AND CLAY DEPOSITS
AT TANGI AND SURROUNDING AREAS
DISTRICT CHARSADDA N.W.F.P.



5.2 GENERAL GEOLOGICAL SETTING/LITHOLOGICAL UNITS

The rocks in the area belong to the Lower Swat Bunair Schistose Group of Martin et al (1960).

Martin et al published the reconnaissance report in 1962 on the geology of the region between the lower Swat and Indus river. They divided the region into the following six group

1. The upper Swat Hornblendic Group.
2. The lower Swat Bunair Schistose Group.
3. The Swat Granitic Gneisses.
4. The Swabi Chamla Sedimentary Group.
5. The Umbela Granite.
6. The Shewa Formation.

The rocks of the reported areas are exposed in the South Eastern part of the Lower Swat Bunair Schistose Group. The Lower Swat Bunair Schistose Group has been intruded by Swat granitic gneisses.

The Lower Swat Bunair Schistose group lies to the south of the upper Swat Hornblendic group and covers most of the Lower Swat, Bunair and North East part of Mardan

Martin et al divided the Lower Swat Bunair Schistose group in the following sub groups:

- e. Green Schists.
- d. Phyllitic Schists.
- c. Marbles and calcareous schists.
- b. Amphibolite Horizon.
- a. Siliceous Schists.

(a). **SILICEOUS SCHISTS.**

The siliceous schists are quartz garnet mica schists, closely associated with the granitic gneisses and occasionally contain beds of amphibolite and crystalline marble.

(b). **AMPHIBOLITE HORIZON**

The Amphibolite are dark green, having abundant hornblend with pale pink garnet, epidote and little feldspar and quartz. The Amphibolite horizon is either underlain or overlain by the calcareous schists and marbles.

(c). **MARBLES AND CALCAREOUS SCHISTS**

The marbles and calcareous schists show interbedding. They occur in Bunair, from where they extend to North into Chakesar area and South West upto Jamal garhi of Mardan district. The Marbles are coarsely crystalline but generally thinly bedded and contain thin layers of Mica and Garnet ampibolite.

The calcareous schists are rich in garnet and mica and they sometime show thin bands of quartzite. Coarse grained Kayanite is found in the formation.

(d). **PHYLLITIC SCHISTS**

The phyllitic schists of the schistose group overly the calcareous schists and grade into the overlying green schists. But the North Western part of the phyllitic schists pass into a zone of garnet mica schists. The phyllitic schists are dark grey and pellitic, with small amount of graphite, siderite, and limonite pseudomorphs.

(e). GREEN SCHISTS

The green schists of the group include chlorite schists, epidote - albite schists, epidote - feldspar - quartz schists, epidote actinolite schists and magnetite - chlorite schists.

Shams (1980) described the Shangla blue schists and considered these to be a part of these green schists. Regarding the age of rocks Bakr and Jackson (1964) put the schistose group in the lower paleozoic age and King (1961) put the carbonate rocks of the schistose group in upper paleozoic.

Apart from these units, Martin et al (1962), described some broken beds of serpentinites, highly altered basic intrusions and feldspathised chlorite schists near the contact with the hornblendic group. The basic intrusions are oftenly associated with sheared schists and quartz - siderite - chlorite schists. Martin et al as well as Danies (1962) have described that the beryl(emerald), occur in the schists and also in associated quartz veins.

Jan(1980) have shown that the green schists including blue schists, serpentine, basic intrusions etc, constitute a high pressure metamorphic zone. He showed that this zone is not a part of the Lower Swat Bunair Schistose group and that this is a faulted block.

Martin et al described that the schistose group have been intruded by the Swat granitic gneisses. These gneisses have been emplaced as sheets of magma, the main sheet of which reaches a few thousand feet in thickness near Ilam. Jan and Tahirkheli (1969) have suggested that the schistose group during the earlier phases of Himalayan orogeny (in middle to late cretaceous time) was intruded by ultramafic rocks (Jijal ultramafics) later on Jan(1977, 79, 80) included these ultramafics under the Jijal complex of Kohistan Island Arc. Jan and Tahirkheli (1969) have also described that during the later phases of Himalayan orogeny (in early tertiary time), the schistose group was intruded by Swat granitic gneisses, granite, granodiorite gneisses, quartz veins and few amphibolite bearing rocks. On the other side Tahirkheli (1980) have

mentioned that the Swat granitic gneisses is the oldest magmatic emanation of the Peshawar valley associated with Gadoon fault of the pre-alpine orogenic episode. But still Tahirkheli et al (1979) have described that the schistose group was intruded by many granitic plutons and suggested that most of these granitic bodies are older than the main tectonics (Cretaceous - Tertiary Tectonics i.e collision of Eurasian plates), while some were intruded during and after the main tectonics and metamorphic events.

Shams (1963a) described the production of skarns in the schistose group by the alteration of a calcareous xenolith with in the granite gneisses of Manglore area, Swat.

A general Geological map is prepared on scale 1:50,000. (Fig-1).

Describing the structure of the schistose group Martin et al have mentioned lineations, folds, drag folds and other intraformational deformations. The folds are syntectonic and they reflect two predominant directions; a North East ward and South West ward. The lineations are due to fold replies or cleavage fractures.

Tahirkheli et al (1979) described that the Lower Swat Bunair schistose group under thrust against the Kohistan Island Arc along the M.M.T. They described that the Schistose Group consist of shales and mica schists, with some ortho-gneisses, amphibolites and marbles. The metamorphism of the rocks increase toward the M.M.T. Severe deformation of the rocks resulted in foliation, lineations and folds. They are of view that the foliation with a general south or north or north - north west dip direction is due to the intense deformation caused by the over thrusting of Kohistan Island Arc during the collision of the Eurasian and Indo Pakistan plates in late Mesozoic or early Tertiary time. They supported the idea by the fact that the foliation in the Kohistan sequence and Schistose Group is parallel to the M.M.T. This phase of deformation also produced North - South trending isoclinal folds.

5.4 LOCAL GEOLOGY

The Qaroon Dehri hillocks comprises of dolomitic Limestone having its upper and lower contact with schists.

The Limestone is fine grained, compact and massive light grey in color. The weathered surface is yellowish in color due to iron leaching.

Generally the trend of the beds is in North East direction while dipping in the North West direction. The hillocks of Qaroon Dehri are seems to be a limb of Anticline of the lower Swat Bunair Schistose rocks in the East and West direction.

The marbalized Limestone of Munda Qila area, Mohmand Agency is interbedded with in the schists of lower Bunair schistose group. The Limestone is fine to medium grained, marblaized, compact, massive and light grey in color. Thickness of the bed is about 30 k.m running in the North West direction for a distance of about more than 2500 m. The Limestone bed is dipping almost vertically, having its both contacts with the schists.

5.5 SAMPLING AND CHEMICAL ANALYSIS

The Limestone deposits at Qaroon dehri were sampled and 3 Nos(TL-5,TL-6,TL-7) rock samples were collected from different locations of these deposits. These samples were analyzed for CaO, MgO, SiO₂, Fe₂O₃, Al₂O₃, K₂O, Cl, SO₃ and L.O.I. at Mineral Testing Laboratory, SDA Peshawar .The chemical analysis results of these samples show the average content of CaO 34.34%, SiO₂ 1.88%, Fe₂O₃ 0.47%, Al₂O₃ 0.21%, K₂O 0.05%, Cl 0.34%, SO₃ 0.19%, K₂O 0.05% and L.O.I. 43.5%.

10 Nos rocks samples were collected from the Limestone deposits of Jud Baba Ziarat-Munda Qila area Mohmand Agency. 8 Nos of these samples i.e. TL-1, TL-2, TL-3, TL-4, TL-12, TL-13, TL-14 and TL-15 were analyzed for CaO, MgO, SiO₂, Fe₂O₃, Al₂O₃, K₂O, Cl, SO₃ and L.O.I. (Table-5.1).

The analysis results of these samples show an average content CaO 53.36%, MgO 0.61%, SiO₂ 1.86%, Fe₂O₃ 0.25%, Al₂O₃ 0.41%, K₂O 0.049%, Cl 0.28%, SO₃ 0.214% and L.O.I. 42.4%(Table 5.1

Table.5.1

**ANALYSIS RESULTS OF ROCK/CHIP SAMPLES
COLLECTED FROM THE LIMESTONE DEPOSITS
AT TANGI AND SURROUNDING AREAS**

Sample No.	CaO %	MgO %	SiO ₂ %	Fe ₂ O ₃ %	Al ₂ O ₃ %	K ₂ O %	Cl %	So ₃ %	L.O.I %
TL-1	52.00	0.43	5.20	0.17	0.15	0.01	0.53	0.01	40.27
TL-2	53.76	0.33	0.98	0.28	0.16	0.02	0.35	0.010	43.24
TL-3	47.04	0.49	14.56	0.37	0.14	0.026	0.50	0.013	36.80
TL-4	45.24	0.44	17.98	0.34	0.12	0.026	0.56	0.014	35.01
TL-5	36.0	17.00	1.50	0.57	0.13	0.54	0.54	0.011	44.00
TL-6	37.00	17.00	1.50	0.52	0.14	0.048	0.32	0.020	43.00
TL-7	31.68	20.12	2.26	0.41	0.28	0.060	0.35	0.017	44.00
TL-12	54.09	0.66	1.88	0.24	0.14	0.160	0.29	0.019	42.10
TL-13	53.00	0.49	1.92	0.18	0.42	0.012	0.30	0.015	43.00
TL-14	53.00	0.61	1.64	0.28	0.80	0.012	0.25	0.010	42.50
TL-15	53.26	0.66	2.00	0.31	0.28	0.013	0.29	0.012	42.00

All the samples analyzed chemically were also studied petrographically. Thin sections of the samples nos TL - 6, TL - 7, TL - 12, TL - 13, TL - 14 and TL - 15 were prepared. These sections have been studied in detail under the transmitted light microscope and the following two main types of Lime Stones have been identified:

1. Recrystallized Limestone.

2. Dolomitic Limestone.

1. The recrystallized Lime Stone is mostly equigranular interlocking texture. Slight foliation and parallel alignment of crystals which are comparatively big grains is common. Mostly there is no cementing material is present. The samples collected from the Lime Stone at Jud baba ziarat area Mohmand agency (TL-12 to TL-15) belong to this group of Lime Stone.
2. In Dolomitic Lime Stone , dolomite replaces calcite partially.

The samples collected from the Lime Stone deposits at Qaroon dehri Tangi area (TL-6, TL-7) are belonging to the Dolomitic Lime Stone group. In addition to calcite and dolomite , iron oxide, mica, and quartz are also present.

5.7 **INFERRED RESERVES OF LIMESTONE DEPOSITS AT TANGI AND SURROUNDING AREAS**

The inferred reserves of Limestone deposits at Qaroon dehri Tangi and Jud Baba Ziarat-Mohmand Agency were calculated to the tune of 1.68 m.m/t and 31.5 m.m/t respectively with the following detail:

(A). **INFERRED RESERVES OF LIMESTONE DEPOSITS AT QAROON DEHRI-TANGI AREA-DISTRICT CHARSADE**

The Limestone deposits of Qaroon dehri- Tangi area are outcropping in the form of small hillocks, having about 500 m length with 20 m thickness and dip depth of about 60 m.

This Limestone is dolomitic in nature, highly fractured and joined, fine grained, containing marly material with in the fractures and yellowish gray in color.

The chemical analysis results of the samples collected from these deposits are shown in the following table.

Sample No.	CaO %	MgO %	SiO ₂ %	Fe ₂ O ₃ %	Al ₂ O ₃ %	K ₂ O %	Cl %	So ₃ %	L.O.I %
TL-5	36.0	17.00	1.50	0.57	0.13	0.54	0.54	0.011	44.00
TL-6	37.0	17.00	1.50	0.52	0.14	0.048	0.32	0.020	43.00
TL-7	31.0	20.12	2.26	0.41	0.28	0.060	0.017	0.017	44.00

As indicated by the chemical analysis results the rocks contain CaO 34.38%, MgO 18.56%, SiO₂ 1.88%, Fe₂O₃ 0.47%, Al₂O₃ 0.21%, K₂O 0.5%, Cl 0.34%, So₃ 0.19% and L.O.I 43.5%.

To calculate the inferred reserves, at Qaroon dehri- Tangi area the following measurements were taken.

Length of the Limestone out crop = 500 m.
 Thickness. = 20 m.
 Depth. = 60 m.
 Sp.gravity. = 2.8%
 Tonnage = 500 x 20 x 60 x 2.8 = 1.68 m.m.t

(B). **INFERRED RESERVES OF LIMESTONE DEPOSITS JUD BABA ZIARATT AREA MOHMAND AGENCY**

The Limestone deposits at Jud Baba Ziarat area Mohmand Agency is in the form of a thick bed interbedded with in the schists, running for a length of about 2500 m. The bed has a thickness of 30 m. with dip depth of 150 m.

The chemical analysis results of the samples collected from these deposits area are shown in the following table.

Sample No.	CaO %	MgO %	SiO ₂ %	Fe ₂ O ₃ %	Al ₂ O ₃ %	K ₂ O %	Cl %	So ₃ %	L.O.I %
TL-1	52.00	0.43	5.20	0.17	0.15	0.01	0.53	0.01	40.27
TL-2	53.76	0.33	0.98	0.28	0.16	0.02	0.35	0.010	43.24
TL-3	47.04	0.49	14.56	0.37	0.14	0.026	0.50	0.013	36.80
TL-4	45.24	0.44	17.98	0.34	0.12	0.026	0.56	0.014	35.01
TL-12	54.09	0.66	1.88	0.24	0.14	0.160	0.29	0.019	42.10
TL-13	53.00	0.49	1.92	0.18	0.42	0.012	0.30	0.015	43.00
TL-14	53.00	0.61	1.64	0.28	0.80	0.012	0.25	0.010	42.50
TL-15	53.26	0.66	2.00	0.31	0.28	0.013	0.29	0.012	42.00

The chemical analysis results are showing that these rocks contain CaO 53.36%, MgO 0.61%, SiO₂ 1.86%, Fe₂O₃ 0.25%, Al₂O₃ 0.41%, K₂O 0.049%, Cl 0.28% and L.O.I. 42.4% in average.

As indicated by the results these Limestone deposits are suitable for cement manufacturing. To calculate the inferred reserves the following measurements were taken and the reserves were calculated to a tune of 31.5 m.m/t in inferred category.

Length of the Limestone Out Crop = 2500 m.
 Thickness of Limestone Out Crop. = 30 m
 Depth. = 150 m.
 Sp.gravity. = 2.8%
 Inferred Reserves = 2500 x 30 x 150 x 2.8 = 31.5 m.m/t

5.8 CLAY DEPOSITS

Clay is one of the most important additives used in manufacturing of portland cement. Clay is a fine grained earthy material which is a mixture of different minerals. Clay is a hydrated silicate with defined chemical composition and crystal structure.

Raw materials used for manufacture of portland cement should contain 70 - 75% of CaO, and 20 - 25% of clay substance.

Tangi is located in Peshawar plain and huge deposits of clay is present in the plain area near by the vicinity of water in the area the plains having fine quality of clay is being used as agriculture land.

A clay sample was collected from the clay deposits near Qaroon dehri, Tangi area. The chemical analysis result of sample shows CaO 4.47%, MgO 1.32%, SiO₂ 57%, Fe₂O₃ 4%, Al₂O₃ 13.48%, K₂O 3.25%, Cl 0.42%, So₃ 0.06% and L.O.I. 12.55%.

Tangi is situated in Peshawar Plain and huge deposits of clay is present in the plain area near by the vicinity of Limestone deposits. Due to the availability of plenty of water in the area the plains having fine quality of clay is being used as agriculture land.

The Limestone deposits of Tangi and Mohmand Agency are easily approachable by all weather road from Peshawar, the head quarter of NWFP, covering a distance of about 70 kilometers. The area is drained by Swat river, therefore a plenty of water is available in the area. Beside the above mentioned important facilities for cement plant, an adequate amount of electric power is also available near by the Limestone deposits.

5.10 CONCLUSION AND RECOMMENDATIONS

The Carbonates of Qaroon Dehri Tangi area were analyzed and the analyses results reveal that these Carbonates are dolomitic in nature and not feasible for cement manufacturing. The inferred reserves are also insufficient for basing a cement plant in the area.

The carbonates of Jud bada ziarat Munda Qila area Mohmand Agency show favorable chemical results for cement manufacturing.

The inferred reserves of these deposits also favors for installation of a mini cement plant in the area.

In order to asses the viability of carbonates of Mohmand Agency for the use in cement manufacturing and to know the exact quality and quantity of Limestone deposits in Mohmand Agency a detailed geological exploration, comprising geological mapping, detailed sampling and core drilling is required.

It is worth mentioning that the Limestone deposits of Jud bada ziarat Munda Qila area Mohmand Agency are located in the federally administrated tribal area, and is out of the jurisdiction of the provincial government, so FATA Development Corporation may be asked for detail geological exploration of the reported Limestone deposits in the area.

**LIMESTONE AND CLAY DEPOSITS
AT LACHI AREA
DISTRICT KOHAT
N.W.F.P.**

6.1 INTRODUCTION

The Limestone and clay deposits near Lachi area Kohat were Geological studied in order to assess the quality and quantity of Raw Materials required for a cement plant in the area.

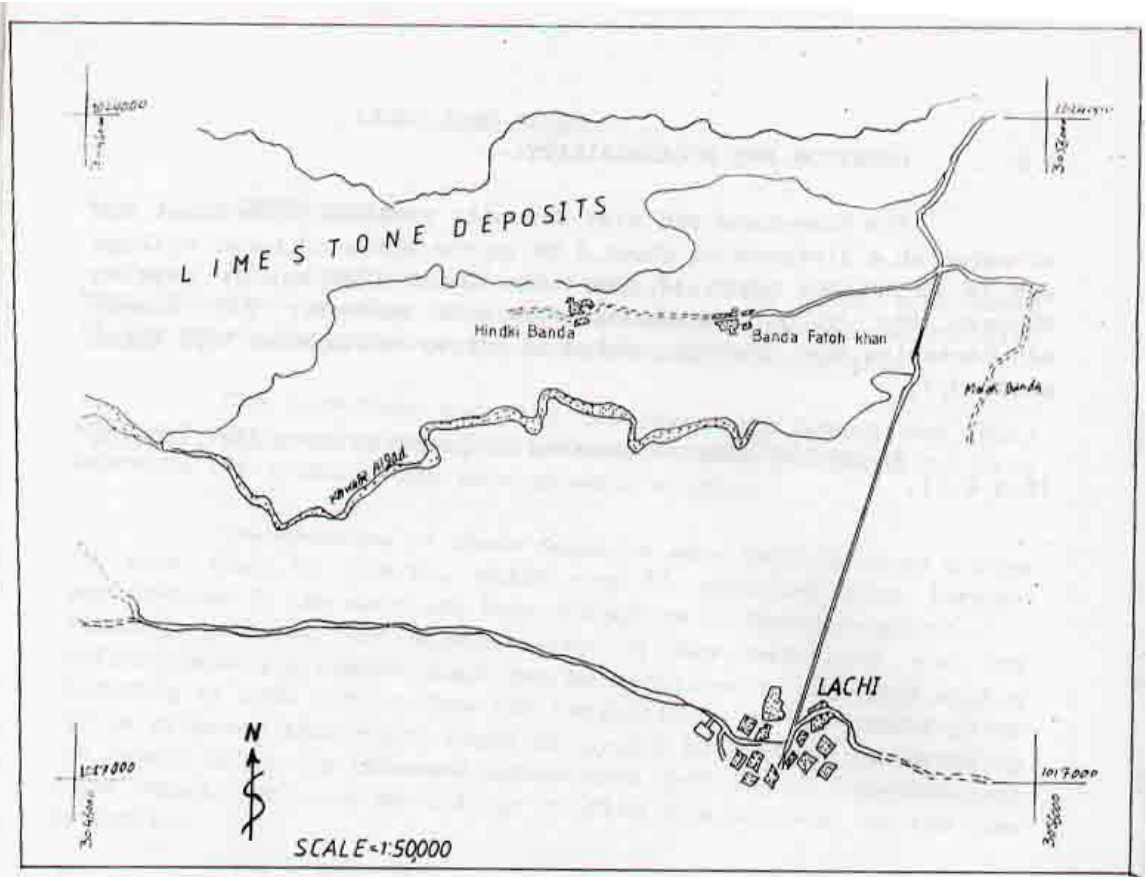
The Limestone and clay deposits were mapped and Rock/Chip and grab samples were collected from these Limestone and Clay deposits for chemical and petrographic studies.

The Reserves of these deposits were calculated to a tune of more than 90 m.m.t., which can be enhanced with further exploration in the West and East direction of these deposits. Keeping in view the availability of Raw materials and the infrastructure a cement plant can be installed in the area with a capacity of 2000 TPD. Before the installation of the cement plant it is proposed that these deposits should be studied geologically in detail and a few thousand meters core drilling in Limestone and Clay should be carried out to confirm the quality of the raw material.

6.2 LOCATION AND ACCESSIBILITY:-

The Limestone and clay deposits of Lachi area Kohat are situated at a distance of about 8 km to the North of Lachi village and 16 Km to the South of Kohat. The Indus High way is passing through the hills containing the raw material for cement manufacturing. The area is located on Survey of Pakistan Topo sheet No.38 O/7.

A location Map of the area is prepared on Scale 1:50,000 (Fig 6.1).



LOCATION MAP OF LACHI LIMESTONE & CLAY DEPOSITS

FIG NO 6.1

6.3 TOPOGRAPHY AND CLIMATE:-

The area is marked by rugged topography. The Lachi area falls in the region of sub tropical continental low land of climate. The weather normally remain dry with poor rain fall.

The winters are cold and the summer are hot. In the months of June and July the temperature ranges from 40° - 47°.

6.4 **GENERAL GEOLOGY:-**

The Lachi area is entirely covered by the sedimentary rocks of Eocene to Miocene age. The sedimentary sequence is subjected to intense folding and faulting.

The North and North Eastern part of Lachi area is composed of Kohat plains.

Numerous low and parallel ridges represent the anticlinal axis whereas the plains represent troughs of synclinal structure.

Generally the rocks strikes in East-West direction. A General Geological and samples locations map of Limestone and Clay deposits at Lachi area Kohat is prepared on scale 1:50,000 (Fig 6.1)

6.5 STRATIGRAPHY:-

Stratigraphically the Rawalpindi group of Miocene is unconformably overlying the Cherat Group. The Murree formation of Rawalpindi group is exposed in the area along with Jatta Gypsum formation, Kuldania formation and Kohat formation of Cherat group. The Sewalik group having Dhok Pathan, Nagri and Chinji formation is missing in this area. Jatta Gypsum formation is not exposed in the mapped area.

Details of various formations exposed in the area are as follows:

I. KOHAT FORMATION:

This formation is mainly composed of massive to nodular, light grey to cream colored Limestone and olive green shale. It has been divided into three different members which are as follows:

1. Habib Rahi Limestone Member.
2. Sadkal Shale Member.
3. Kala Dhand Member.

II. HABIB RAHI LIMESTONE MEMBER

The Limestone formation included in this group has been surveyed recently by SDA for the manufacturing of the proposed Cement Plant near Lachi.

The Limestone under this group is crystalline, hard, compact thick bedded, massive but shattered and brachiated at the top 3 to 4 meters, where calcite veins are common. This group has a good %age of CaO ranging from 50-54% with an appreciable thickness for mining purposes. The over all chemical composition of the Limestone under this group has proved its suitability as a single component of the calcareous material for the manufacturing of port land cement. All the ridges exposed in the area and elsewhere in the vicinity are formed by this Limestone. The general strike is East West and beds dip steeply from 45° to 80°. The

thickness of the Limestone formation in the surveyed area is ranging from 30 meters to more than one hundred meters.

III. SADKAL SHALE MEMBER

This member is composed of greenish grey calcareous shale and light grey Limestone (at places) flooded with nummulites. It is difficult to differentiate it from the Kaladhand member.

IV. KALADHAND MEMBER

Elsewhere this member is represented as Limestone which is thick bedded, light grey in color. it is associated with grey shale and is overlain by sadkal shale member. Stratigraphically Kaladhand member is the oldest member of the Kohat formation and rest conformably with Kuldana formation, but at some places it has a direct contact with Habib Rahi Limestone.

V. KULDANA FORMATION

This formation is dominantly composed of brownish red to red, calcareous and silty shale, and occasional thin beds of marl. Marl beds in the study area does not seem to be exposed, however elsewhere it is significantly exposed.

VI ALLUVIAL CLAY

The alluvial clay has sufficient oxides percentage to design a suitable raw mix with Habib Rahi Limestone. It can be used as a single argillaceous component for making the portland Cement.

The alluvial clay stretches over the flood plains and also lies in conjunction to South and North of the Limestone Limit. The reserves of this alluvial clay are enormous and can feed the proposed plant for several years.

The Limestone deposits of Lachi area were sampled and 09 Nos chip/rock samples (LSKT-320 to LSKT-328) were collected from different localities of these deposits. These samples were chemically analyzed for CaO, MgO, SiO₂, Fe₂O₃, Al₂O₃, Na₂O₃, K₂O, Cl, So, and L.O.I.

The chemical analysis results of all the samples are showing in the following table No 6.1 and are suitable for cement grade.

Table No 6.1

**ANALYSIS RESULTS OF ROCK/CHIP SAMPLES
COLLECTED FROM THE LIMESTONE DEPOSITS
AT LACHI AREA KOHAT**

S.NO.	SAMPLE NO	CaO %	MgO %	Al2O3 %	Fe2O3 %	SiO2 %	Na2O %	K2O %	SO3 %	Cl %	L.O.I %
1.	LSKT-320	52.64	0.16	0.01	0.10	4.76	0.18	0.02	0.12	0.14	41.52
2.	LSKT-321	53.08	0.13	0.18	0.18	2.66	0.20	0.01	0.09	0.10	42.17
3.	LSKT-322	51.29	0.11	0.07	0.18	6.10	0.20	0.01	0.14	0.15	40.88
4.	LSKT-323	51.96	0.13	0.12	0.29	3.78	0.22	0.01	0.15	0.18	42.03
5.	LSKT-324	51.52	0.13	0.11	0.14	3.90	0.20	0.02	0.17	0.16	42.00
6.	LSKT-325	51.29	0.11	0.22	0.18	4.84	0.20	0.02	0.14	0.15	41.78
7.	LSKT-326	51.07	0.11	0.18	0.18	5.38	0.20	0.01	0.16	0.17	41.63
8.	LSKT-327	51.29	0.13	0.11	0.21	4.02	0.22	0.01	0.15	0.13	42.31
9.	LSKT-328	49.50	0.13	0.21	0.47	7.58	0.18	0.02	0.17	0.15	40.39

6.7 INFERRED RESERVES OF LIMESTONE DEPOSITS LACHI AREA KOHAT

The Limestone deposits at Lachi area Kohat were calculated to a tune of 112 m.m.t in Inferred category with the following detail.

Length of Limestone Outcrops.	=	5000 m
Average Width of The Limestone Deposits	=	100 m
Average Depth.	=	80 m
Sp.gravity	=	2.8
Reserves: 5000X100X80X2.8	=	112 m.m.t

6.8 CLAY DEPOSITS OF LACHI AREA KOHAT.

The huge clay deposits at the foot hills of Lachi Limestone and the Mami Khel clay can be used for cement manufacturing 08 No. grab samples (CLKT-69 to CLKT-76) of clay were collected from the clay deposits and were analyzed for CaO, MgO, Al₂O₃, Fe₂O₃, SiO₂, Na₂O, K₂O, SO₃, Cl and L.O.I. The chemical analysis results are shown in the following table. The chemical composition indicate that the clay is suitable for cement manufacturing.

(Table 6.2)

Along the clay another important additive use in cement manufacturing i.e Gypsum deposits are also present at a few kms distance to the south of Lachi area.

TABLE NO. 6.2

**ANALYSIS RESULTS OF CLAY SAMPLES
COLLECTED FROM TH CLAY
AT LACHI AREA KOHA**

S.NO.	SAMPLE NO	CaO %	MgO %	Al2O3 %	Fe2O3 %	SiO2 %	Na2O %	K2O %	SO3 %	Cl %	L.O.I %
1.	CLKT-69	6.96	0.99	14.40	-	54.00	2.83	3.25	0.37	0.31	13.00
2.	CLKT-70	6.73	1.16	14.20	-	53.60	3.09	3.25	0.35	0.30	13.24
3.	CLKT-71	5.49	1.49	13.90	-	55.00	3.50	3.97	0.31	0.29	12.00
4.	CLKT-72	4.48	1.49	12.90	-	54.40	3.63	4.81	0.34	0.27	12.66
5.	CLKT-73	5.16	1.49	14.60	-	54.40	3.36	4.09	0.35	0.25	12.56
6.	CLKT-74	6.94	1.32	13.30	-	51.20	3.09	3.85	0.32	0.23	14.47
7.	CLKT-75	15.68	1.16	10.80	-	35.90	2.69	2.77	0.29	0.26	24.65
8.	CLKT-76	17.47	0.82	10.90	-	35.50	2.83	2.28	0.27	0.25	24.75

The area is plain and is connected with Kohat at a distance of about 16 Km through the main Indus high way. The Limestone and Clay deposits are easily approach able from Kohat. Lachi is a prominent town in the area and is located at a distance of about 8 Km to the South of the Limestone deposits.

Water is also available at shallow depth in the area. Besides the fore mentioned facilities, electric power, health and education facilities etc are available in the area.

The preliminary geological study carried out in the area indicated abundant quantities of good quality Limestone and additive materials in the surroundings of Lachi area, and can be considered suitable for Cement manufacturing.

All the samples collected from Limestone and Clay deposits have been made from the surface without having any knowledge about the depth, it is therefore important to conduct about 1000 meters Core drilling on Limestone and 300 meters Core drilling on Clay deposits in order to confirm average grade of Limestone and clay deposits.

The estimated reserves of Limestone exposed on the surface near Lachi area comes to the tune of about 112 million tones and are sufficient to last for about 2000 tones/day cement production. Similarly huge deposits of good quality clay exposed near the Limestone deposits also indicate a better prospects for an installation of a cement plant near Lachi area. Other additives required in small quantity like Gypsum, Silica Sand and Iron Ore are also available in the area with in an economic range for the cement productions.

**LIMESTONE AND CLAY DEPOSITS
AT GADWALIAN AREA
DISTRICT HARIPUR
N.W.F.P.**

7.

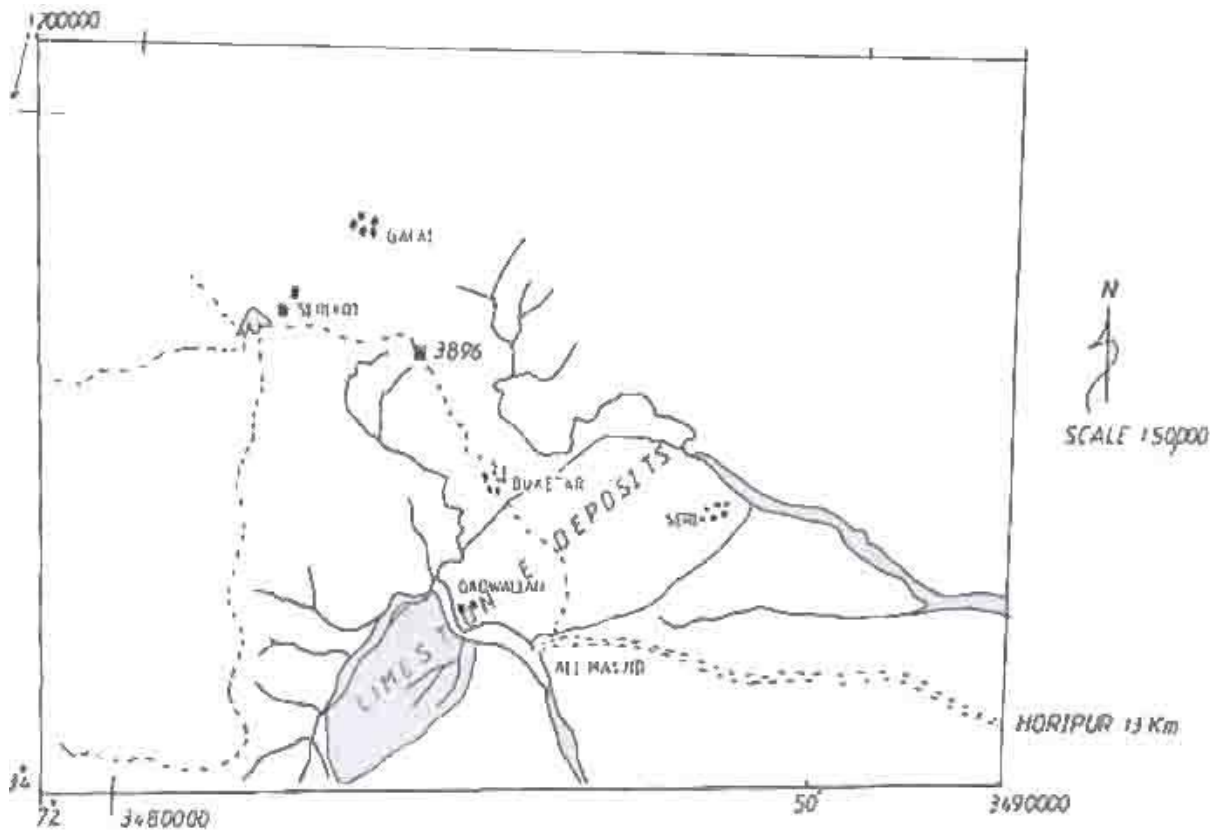
GADWALIAN-AREA-HARIPUR

7.1

INTRODUCTION:

The Limestone deposits of Gadwalian Area Haripur are located on Survey of Pakistan Topo sheet No 43B/16 between Longitude $34^{\circ}-2'-3''$ and Latitude $72^{\circ}-6'-15''$ near Gadwalian village on Haripur-Sirikot Road, at a distance of 12 Km in the NW direction of Haripur Town.

At the foot hills of the Limestone deposits alluvium deposits are present which is used as cultivated land. However the Slates/Phyllites of Tanawal formation can be used as a substitute of Clay. Further more huge clay deposits are also available near Haripur on the main Haripur Taxila road at a distance of about 30 Km.



LOCATION MAP OF LIME STONE DEPOSITS
GADWALIAN AREA SIRIKOT HARIPUR

7.2 GENERAL GEOLOGICAL SETTING

Generally the geology of the area comprises of:

a. Precambrian rocks of Salkhala formation:

The Salkhala Formation of precambrian age forms much of the bed rock on the West bank of the Indus. The formation consists of inter layered green and brown chlorite-mica-quartz schists, marble, calcareous schists and graphitic schists.

b. Paleozoic rocks of Hazara Formation:

The Hazara formation consists mainly of black slates, brown and black phyllite and un-metamorphosed shale, silt and gray wack, Hazara formation also contain a narrow conspicuous belt of deformed Limestone, which is in fault contact with the quartzite of the overlying Tanawal formation.

c. Silurian or Devonian rocks of Tanawal Formation:

The Tanawal formation consists primarily of medium and coarse grained quartzite (quartzose sandstone). The quartzite is well bedded in layers.

d. Carboniferous to permian rocks of Abbotabad Formation.

The Abbotabad formation forms the low hills on the East bank of the Indus. The Abbotabad formation in the area consists of brown and gray dolomite and green phyllite and quartzose sandstone are intercalated in it.

The area is regionally characterized by four structural faults separated by three main boundary faults, called the Darband, Tanawai and Jehlum Faults. They are strike slip faults, with associated vertical movement along which each individual block has moved generally southward and upward relative to its neighboring block on East. In places the boundary faults change into thrust faults for short distances. As a result of the cumulative uplift in step like fashion (West side up) successively older rocks are exposed in westerly direction from late tertiary rocks in the axial zone of Hazara-Kashmir syntaxis, to Precambrian Salkhala Formation in the block west of the Darband fault.

The Darband Fault separates Salkhala and Tanawal formations. The Darband fault is exposed on the West bank of the Indus about 1 mile north of Pehur village where it forms a wide vertically dipping shear zone trending East and South East.

A system of large, nearly symmetrical folds, plunging north east, characterizes the area South and East of the Darband Fault. On the east bank of the Indus, two juxtaposed syncline of this fold system are outlined by the Tanawal quartzite, which occupies the troughs of the folds.

The Limestone deposits at Gadwalian Haripur were sampled and 05 No. chip samples (LS75-LS79) were collected from these deposits. These samples were studied petrographically and were analyzed of CaO, MgO, SiO₂, Fe₂O₃, Al₂O₃, Na₂O, K₂O, Cl, SO₃ and L.O.I.

The results of chemical analysis are shown in the following table No. 7.1.

Table No.7.1

**ANALYSIS RESULTS OF ROCK/CHIP SAMPLES
COLLECTED FROM THE LIMESTONE DEPOSITS
AT GAWALIAN AREA HARIPUR**

Sample No.	CaO %	MgO %	SiO ₂ %	Fe ₂ O ₃ %	Al ₂ O ₃ %	K ₂ O %	Cl %	SO ₃ %	L.O.I %
LS-75	51.96	2.80	4.00	0.27	0.07	0.036	0.14	0.015	39.95
LS-76	53.08	0.80	1.18	0.25	0.05	0.024	0.18	0.016	43.93
LS-77	54.20	0.68	0.95	0.20	0.04	0.024	0.14	0.013	43.28
LS-78	55.00	0.66	0.88	0.14	0.05	0.016	0.12	0.014	42.87
LS-79	52.64	1.70	1.26	0.33	0.06	0.03	0.14	0.018	43.38

All the samples were studied petrographically. Thin sections of the samples (LS-75-LS79) were prepared. These sections have been studied under the microscope to find the exact type of limestone and to identify the associated minerals. The microscopic study is also aided by staining test. Detail is as follows.

i. Sample No. LS-75

The rock shows composite quartz grains in which not only the crystal boundaries within the grain are sutured but also the crystals are elongated in preferred orientation. Such quartz grains are called sheared quartz. They show undue loose extinction.

The mica flakes also show preferential alignment resulting into schistose texture. Such rocks are some time classified as schistose quartz rock.

ii Sample No. LS-76

The grains are mostly fine but equal in size. The recrystallized grains are present in disseminated form. They are also compact. Few dolomite grains and opaque minerals are present.

iii. Sample No. LS-77

The sample contains mosaic of equi-granular calcite. Most of the grains are partially re-crystallized. They are almost aligned in preferred orientation. This sample is non-fossiliferous. Quartz grains are also broken. The rock is partially recrystallized limestone.

iv. Sample No. LS-78

Compositively and texturally this sample is same as of sample No. LSS-77 except few grains of recrystallized calcite are also present. The grains present are not oriented in identical direction. No fossil present in this sample beside calcite which is dominant, dolomite, quartz and opaque minerals are also present.

v. Sample No. LS-79

Amorphous carbonate is more abundant. Few dolomite grains present are inter-related with calcite grains. Quartz and opaque minerals are present as inclusion in calcite.

7.6 INFERRED RESERVES.

The reserves of Limestone deposits at Gadwalian Haripur were calculated into inferred category to a tune of 135 m.m.t.

Detail is as follows:

Length of the Limestone Out Crop	=	2000 m
Width of the Limestone Out Crop	=	120 m
Depth	=	50 m
Sp.gravuty	=	2.8
Inferred Reserves	=	33.6 135.0 m.m.t

The Limestone deposits were geologically studied. These deposits have been sampled and the chemical analysis results are encouraging. The reserves of these deposits are also of small quantity. To decide for installation of a cement plant in the area on the basis of these deposits the following parameter should be studied in detail.

1. Detail geological mapping/investigation of these deposits should be carried out.
2. Detail sampling of the deposits should be carried out.
3. The phylites/slates deposits which have on upper contact with the Limestone deposits should be studied in view to be used as clay in the manufacturing of portland cement.

MARKET REPORT ON CEMENT

The Cement units are numbered and there is no production in the unorganized sector so, there is no confusion regarding availability of statistics on cement.

The available data on the cement consumption/production indicates that there has been no uniformity in the consumption pattern of cement. From 1976 to 1992, the growth rate of consumption has been fluctuating between 4% to 12%. However, different consultants have agreed on a growth rate of 8% and is confirmed from the historical data of production/ consumption of cement from 1982-83 to 1992-93 given below:-

Pakistan - Apparent Consumption of Cement

<u>Year</u>	<u>Annexure-1 (000, Tons)</u>			
	<u>Production</u>	<u>Imports</u>	<u>Exports</u>	<u>Apparent Consumption</u>
1982-83	3938	686	-	4624
1983-84	4503	884	-	5387
1984-85	4749	734	-	5483
1985-86	5773	194	-	5962
1986-87	6508	56	-	6564
1987-88	7072	21	-	7093
1988-89	7213	40	-	7253
1989-90	7448	19	-	7467
1990-91	7796	30	-	7826
1991-92	8321	06	-	8327
1992-93	8556	26	-	8584

STATEMENT NO.1

Source: Upto 1982-83, production from CBR, Exports from CSO. After 1982-83 upto 1984-85 SCCP estimates for World Bank. 1985-86 Economic Survey. From 1988-89 CHEMOON DATA. 1991-92 from Economic Survey. 1987-88 also from Economic Survey.

Note: CSO figures for imports from 1982-83 upto 1984-85 are slightly different, but not materially so. From 1985-86 Foreign Trade Statistics used. In 1992-93 imports were White Cement mainly.

It is agreed by all experts/statisticians that 70-72% of the population is dwelling in rural area, are switching over to the use of cement for the construction of their houses.

The following factors play a significant role in the consumption of cement:-

- 1). Remittances of workers abroad.
- 2). Availability of cement at village level.
- 3). Price trend of cement.
- 4). Growth in G.N.P.
- 5). Construction of National high ways, dams, hydel powers etc.
- 6). Export to Afghanistan for rehabilitation programme and Central Asian Republic.

The growth in consumption/production remained stagnant in Sindh/Sough zone because of ethnic riots/political disturbances. However, the revolutionary development programme as committed by foreign investors in Sindh and Baluchistan, will very sharply enhance the use of cement in the southern zone. According to the following statement of Mr. Mohammad Hassain Dadabhoy appearing in the Daily DAWN of 30th April, 1993 that demand in south will accelerate at 8% per annum from 1992-93 and probably 10% from subsequent year.

"It is envisaged that positive and encouraging policies of the Government, coupled with expected improvements in the social and political environment, economic development of the southern regions would certainly result in higher demand for cement than has been witnessed in recent years".

It would not be unreasonable to project an acceleration in the demand for cement in the southern region upto eight per cent per annum from 1992-93 and probably ten per cent for subsequent periods.

Keeping in view the production of 1992-93 as a base and projecting the future demand @ Rs. 8% growth rate, the demand/production projections for the subsequent years are given below:-

Annexure - II

<u>Year</u>	<u>Demand (Million Tons)</u>
1993-94	9.706
1994-95	10.482
1995-96	11.321
1996-97	12.226
1997-98	13.204
1998-99	14.260
1999-2000	15.401
2000-2001	16.634
2001-2002	17.964
2002-2003	19.401
2003-2004	20.954

STATEMENT NO. II

This represents the demand estimate which should be reached if cement was freely available.

At present there are 23 plants of cement operating in the country of which 12 are located in the north having combined capacity of 4.5 million tones per annum whereas 11 plants are located in the south with a combined capacity of 3.9 million tones per annum.

Cement production reached over nine million tones in 1993-94 which is 5.5 per cent more compared to 1992-93. Over the past five years, cement production has risen at an annual rate average of about five percent.

CEMENT PLANTS AND THEIR CAPACITIES

S. NO.	NAME OF PLANTS	LOCATION	SCCP/ PRIVATE	ANNUAL CEMENT PRODUCTION CAPACITY('000)
<u>NORTHERN ZONE</u>				
1.	Mustehkam	Hattar (Hazara)	SCCP	660.000
2.	National	Dandot (Jehlum)	SCCP	50.000
3.	Associated	Wah Cant	SCCP	361.000
4.	Pak Cement	Daudkhel	SCCP	189.000
5.	White Cement	Iskandarabad	SCCP	30.000
6.	D.G.Khan	D.G.Khan	Private	630.000
7.	Gharibwal	Gharibwal(Jehlum)	Private	567.000
8.	Maple Leaf	Daudkhel(Mianwali)	Private	583.000
9.	Dandot	Dandot (Jehlum)	Private	315.000
10.	Kohat	Kohat	Private	315.000
11.	Cherat	Lokri (Nowshera)	Private	393.000
12.	Fecto	Sangjani(Islamabad)	Private	630.000
13.	Lucky	D.I.Khan		
14.	AWT	Nizampur		

STATEMENT NO. III

S. NO.	NAME OF PLANTS	LOCATION	SCCP/ PRIVATE	ANNUAL CEMENT PRODUCTION CAPACITY ('000)
1.	Javadan	Karachi	SCCP	660.000
2.	Thatta	Thatta	SCCP	330.000
3.	Associated	Rohri	SCCP	270.000
4.	National	Karachi	Private	160.000
5.	Zeal Pak	Hyderabad	Private	1008.000
6.	Pakland	Dhabeji	Private	441.000
7.	Dadabhoy	Dadu	Private	409.000
8.	Attock	Hub	Private	630.000
9.	Sarela	Darwaza	Private	70.000
10.	Essa	Nooriabad	Private	157.000
11.	Anwar Zeb	Bholari	Private	50.000
				4,126.000
Total capacity of the above 23 units				8,550.00

STATEMENT NO. IV

If capacity of 80,000 ton per annum pertaining to white cement and that of closed units of National (Karachi) and Sarela (Baluchistan) deleted, the net operational capacity comes out to be 8.240 million tons per annum.

FUTURE AVAILABILITY POSITION OF CEMENT

Year	EXISTING UNITS	UNDER IMPLEMENTATION CAPACITIES	SOUTH ZONE	TOTAL SUPPLY
1992-93	4.276	-	3.743	8.019
1993-94	4.276	-	3.743	8.019
1994-95	4.276	1.575	3.743	9.594
1995-96	4.276	1.575	3.743	9.594
1996-97	4.276	3.825	3.743	11.844
1997-98	4.276	4.815	3.743	12.834
1998-99	4.276	5.130	3.743	13.149
1999-2000	4.276	5.130	3.743	13.149
2000-2001	4.276	5.130	3.743	13.149
2001-2002	4.276	5.130	3.743	13.149

STATEMENT NO-V

DETAIL OF NEW/UNDER IMPLEMENTATION CAPACITIES

<u>NAME OF THE PROJECT</u>	<u>PLACE</u>	<u>YEAR OF OPERATION</u>	<u>CAPACITY TONES</u>
Pioneer	Khoshab	1994	630,000
Associated	Wah	1994	630,000
Cherat (Extension)	Nowshera	1994	315,000
Lucky Cement	Pezu(Bannu)	1996	630,000
Army Welfare Trust	Nizampur	1996	630,000
Fauji	Fatehjang	1996	990,000
Fecto (Extension)	Punjab	1997	990,000
Poineer	Khushab	1998	315,000

STATEMENT NO-VI

FUTURE SUPPLY/DEMAND PROJECTIONS

<u>Year</u>	<u>PROJECT DEMAND</u>	<u>SUPPLIES</u>	<u>NET SURPLUS (DEFICITS)</u>
1994-95	10.482	8.019	(2.263)
1995-96	11.321	9.594	(1.727)
1996-97	12.226	9.594	(2.632)
1997-98	11.204	11.844	(1.360)
1998-99	14.260	12.834	(1.426)
1999-2000	15.401	13.149	(2.252)
2000-2001	16.634	13.149	(3.485)
2001-2002	17.964	13.149	(4.815)
2002-2003	19.401	13.149	(6.252)
2003-2004	20.954	13.149	(7.805)

STATEMENT NO.VII

Under this scenario the following additional units will be required to meet the demand.

1995-96	2-3 additional units of 3000 TPDC
1996-97	One additional units of 2000 TPDC

During 1997-98 there will be surplus quantities which may be utilized by Ghazi - Barotha project and other hydel power plants and may also be exported to Afghanistan for rehabilitation etc.

2001-2002 — One unit of 5000 TPDC
 2002-2003 — One unit of 5000 TPDC

This indicates that upto 2002-2003 there will be need for 3 additional units of 3000 TPDC, 2 units of 5000 TPDC and one unit of 2000 tons per day capacity and thereafter 6 units of 3000 tons capacity. It shows that all the capacities of 6 new units could be absorbed till 2002-2003.

This will bring an investment of about Rs.40 billion to the Province which will drastically increase the social and economic parameters of the N.W.F.P, in particular and that of the country in general. These units will generate 4000 jobs opportunities directly and about 15000 indirectly. Above all the untapped mineral resources will be value added.

The above supplies/production has been based on optimum capacity of the existing as well as under implementation projects. Virtually the older units will be partially closed down for major repairs/maintenance, hence, a capacity of 95% is envisaged of the existing/under implementation units and the following position emerges:-

<u>Year</u>	<u>PROJECT DEMAND</u>	<u>SUPPLIES</u>	<u>N E T S U R P L U S</u> <u>(DEFICITS)</u>
1993-94	9.706	7.217	(2.489)
1994-95	10.482	7.618	(2.864)
1995-96	11.321	9.114	(2.207)
1996-97	12.226	9.114	(3.112)
1997-98	11.204	11.251	(1.953)
1998-99	14.260	11.251	(3.009)
1999-2000	15.401	12.193	(3.208)
2000-2001	16.634	12.491	(4.143)
2001-2002	17.964	12.491	(5.473)
2002-2003	19.401	12.491	(6.910)
2003-2004	20.954	12.491	(8.463)

-(126):-

STATEMENT NO-VIII

Under this scenario the following additional capacities will be required to meet the demand.

1995-96	3 units of 3000 TPDC
1996-97	1 units of 2000 TPDC

During 1997-98 there may be surplus quantity which may be absorbed by Ghazi - Barotha and other similar projects.

2001-2002	One unit of 3000 TPDC
2002-2003	One unit of 3000 TPDC
2002-2003	One unit of 5000 TPDC

This indicates that 07 new units will be required to meet the demand as projected upto 2003.

This critical period when cement will be flooded in the market are the years 1997-98 and 1998-99, hence, new up coming units needs to be scheduled in such away that they may not be operational during this critical period.