



**AZAD GOVERNMENT OF
THE STATE OF JAMMU AND KASHMIR**

Construction Material Sources In and Around Azad Jammu and Kashmir

Version 2018

**PLANNING AND DEVELOPMENT DEPARTMENT (P&DD)
MUZAFFARABAD, AJ&K**

DEDICATION

*This study is dedicated to the memory of
thousands of children, women and men lost
in the Kashmir earthquake
of
October 2005*

PREFACE TO THE REVISED EDITION

Naturally occurring construction resources in the form of aggregate, stones and stream gravels contribute the largest material share in civil construction industry. The State of Azad Jammu and Kashmir comprises a large mountainous and hilly terrain with diversified rock and soil types, which can be suitable for civil construction industry. However, due to certain constraints, the optimal advantages of this natural resource could not be managed till now. A few of the resources were known but even those were never investigated systematically with entirety for proper exploitation in favor of the State.

This situation led to almost negligible exploitation of the State's resources and increased dependence on outside resources, causing extra burden to the State treasury in due course. The Planning and Development Department (P&DD); being the concerned accountable state set-up, was incessantly approached by the concerned government departments for amicable resolution of the matter for long term and sustainable development of the State.

In view of the above, an extreme need was sensed by the Planning and Development Department (P&DD) for conducting a comprehensive technical study for evaluating the aggregate and stones resources of the State and its adjoining areas and to prepare necessary support engineering documents essential for application of the study results. Accordingly, a program was conceived in year 2007 comprising following major components:

Part-1: Identification of Construction Material Sources in all Districts of AJ&K

Part-2: Revision of Specification of Construction Material to be used in Roads, Buildings, Bridges etc.

Part-3: Formulation of AJ&K Composite Schedule of Rates (AJ&K-CSR)

Terms of Reference for this study were prepared by the P&D Department in consultation with the concerned departments and the study was entrusted to National Engineering Services Pakistan (Pvt) Limited (NESPAK) in January 2008. Moreover, working groups were formulated by the P&D Department for the purpose of monitoring/ reviewing study as it proceeds. The working groups comprised senior officials from the all concerned departments including Highways, Local Government and Rural Development, Physical Planning and Housing and Forest. Representatives from the Central Design Office (CDO) were specifically included in the Working Groups for technical guidance.

In addition to the above arrangements, the Rate Analysis Section within P&D Department was established for (a) overseeing the study and (b) taking post-study ownership and up-gradation of the study outputs.

After completion of the subject study by M/s NESPAK in 2014, during the course of implementation, it was found that many sources approved were abandoned; corrections were required in recommended uses of various sources. Initially, the study was comprised of 8 districts of AJ&K but currently the administrative setup of AJ&K converted to 10 districts, hence the study was tailored for 10 districts by splitting the data as per the availability and demand of the natural construction materials. Similarly, with advancement in technology advance GIS tools and remote sensing was done to create dynamic maps for user convenience and aesthetics. Advanced geological maps were incorporated and upgraded the earlier versions. Revised General and Technical Specifications were considered for better implementation of the subject study. Similarly, population and administrative setup of AJ&K was upgraded to 2017 census and current legislative boundaries etc.

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CONSTRUCTION MATERIAL SOURCES IN AND AROUND AZAD JAMMU & KASHMIR

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AASHTO	American Association of States Highway and Transport Officials
ACI	American Concrete Institute
ACR	Alkali Carbonate Reaction
AJ&K	Azad Jammu and Kashmir
Approx.	Approximately
ASR	Alkali Silica Reaction
ASTM	American Society for Testing and Material
Av.	Average
BB	Bhimber District
BG	Bagh District
BS	British Standards
CALTRAN	California Department of Transport
CDO	Central Design Office
Cft	Cubic Feet
CMTL	Central Material Testing Laboratories
CSR	Composite Schedule of Rates
DOT	Department of Transport
GGBFS	Ground Granulated Ballast Furnace Slag
KI	Kotli District
kN	Kilo Newton
LAA	Los Angeles Abrasion
max.	Maximum
MBT	Main Boundary Thrust
min.	Minimum
MR	Mirpur District
MZD	Muzaffarabad District
NESPAK	National Engineering Services Pakistan
NHA	National Highway Authority
NM	Neelum District
NWFP	North West Frontier Province
OPC	Ordinary Portland Cement
P&DD	Planning and Development Department
PCA	Portland Cement Association
PN	Poonch District
psi	Pound per Square Inch
PWD	Public Works Department
RRI	Road Research Institute
SD	Sudhnuti District
SRTM	Space Rader Terrain Model
TFV	Ten Percent Fine Value
TRL	Transport Research Laboratory
WAPDA	Water and Power Development Authority

CHAPTER 1

STUDY AND REPORT FORMAT

1.1 Study Format

As per the Terms of Reference and the agreed work sequence, the construction material sources study was split into two segments to make best use of the experiences gained during the execution and avoid chances of repetition of errors. These segments were designated as “**Pilot Study**” and “**Main Study**”.

- **Pilot Study** covering priority districts of Muzaffarabad, Jhelum Valley, Bagh and Haveli.
- **Main Study** covering all remaining districts of the State.

NESPAK completed the Pilot Study, identifying all existing and potential sources in the districts of Muzaffarabad and Bagh. Muzaffarabad and Bagh districts were later further subdivided into Jhelum Valley and Haveli districts.

The study was planned in consultation with the Working Group formed by the P&DD, which comprised senior district officials from the Highways, Buildings and Public Health Engineering Departments. A study coordinator was also appointed for all field activities and necessary facilitation to NESPAK field parties. It is worth mentioning that in the initial stages of the Pilot Study after reviewing the factual situation of the target districts, the Consultant decided to extend the study outside AJ&K to cover the existing as well as potential sources of Pakistan that could be gainfully exploited for the State.

During the currency of studies, detailed presentation was given to the Honorable Prime Minister, Cabinet and on many occasions to Additional Chief Secretary (ACS) and other senior officials from various ministries, wherein important findings of the study completed at various stages were shared. The officials while appreciating the usefulness of the study findings expressed satisfaction over the efforts put in by NESPAK.

Upon completion of the Pilot study, NESPAK extended the study in remaining six districts i.e., Kotli, Bhimber, Mirpur, Neelum, Poonch and Sudhnuti. The main study identified all existing and potential sources in the districts of Kotli, Bhimber, Mirpur, Neelum, Poonch and Sudhnuti. The Main Study was also planned in consultation with the Working Group. A detailed presentation was given to the Additional Chief Secretary (ACS)/ Secretary Planning and Development Department and other senior officials from various departments on October 20, 2011, wherein important findings of the main study completed were shared.

Maximum consultation and utmost involvement of the staff from relevant departments was also been ascertained during the Main Study phase.

Both the Pilot and Main study segments concluded with the submission of interim reports to P&DD and Working Group for review, comments and approval.

1.2 Report Format

Upon approval of the pilot and main study reports, this consolidated report covering the construction material findings of all the districts has been framed in a manner convenient for the target end users. It provides (a) comprehensive summary of relevant base level conditions, (b) study methodology, (c) technical criteria for qualitative and quantitative evaluation of material, (d) details of material sources identified and evaluated during the

study, (e) district-wise material procurement plan, and (f) conclusions and recommendations.

Furthermore, in compliance with the requirements of end users, appendices have also been included into this report covering two specific-use natural material i.e., the natural pozzolana as concrete additive to combat ASR issue, and silty clay deposits for use in structural brick making in Mirpur and Bhimber districts.

No separate study has been conducted for the evaluation of pozzolana ash of the district Haveli. The investigation conducted and report prepared by the Azad Kashmir Minerals and Industrial Development Corporation during 1998 has been reproduced, for which due acknowledgement is being made to the department for its work in this respect.

This volume also includes the soft copy of the consolidated report in Portable Document Format (PDF) on the compact disc.

1.3 Source Digests

The consolidated report is also concluded with production of Source Digests of each of the investigated source in all the districts of the State. These digests contain data pertaining to the following.

1. Location, Accessibility, Terrain and Geology
2. Qualitative and Quantitative Evaluation of Sources
3. Laboratory Test Results
4. Petrographic Evaluation
5. Rapid Environmental Appraisal
6. Geologic Map and Photographic Illustrations
7. Major Findings and Recommendations

The voluminous data of source digests have been provided separately to P&DD for reference.

CHAPTER 2

BASE LEVEL INFORMATION FOR STUDY PLANNING

2.1 General

A systematic effort was made to gather relevant base level information necessary for planning and defining the study. The information collected included (a) administrative set-up, (b) physiography and infrastructure, (c) previous relevant studies, (d) prevailing construction practices, (e) cement types used, (f) items relevant to construction material covered in the current Composite Schedule of Rates (CSR). Based on the review of this information important construction material issues were identified to comprehend study planning and methodology.

This chapter provides details of all the information collected and important concerns required to be addressed during the study. These concerns were discussed with the Working Group and Rate Analysis Section formed by the Client and necessary planning aspects were finalized.

2.2 Administrative Setup and Population Distribution

The State of Azad Jammu and Kashmir (AJ&K) is the southern part of the Pakistan-administered Kashmir. It locates between longitude 73° and 75° and latitude 33° and 36°. It has a linear outline with 13,297 km² area, which is about 400 km long with width varying between 15 and 40 km. It borders Indian Occupied Jammu and Kashmir to the east, Northern Areas of Pakistan to the north and KPK and Punjab to the west.

The State administrative matters are run by the President, Prime Minister, Legislative Assembly, and Supreme Court. The financial matters are dealt through Annual Development Program with the grant of funds every year in the budget. After the dissolution of Azad Jammu and Kashmir Council, AJ&K has its own taxation system and the projects are executed through ministry of Planning and Development and Finance Department through set yard stick of ADP formulation and meet the normal finances through recurrent budget executed by finance department.

Muzaffarabad is the State capital. The State is administratively divided into three divisions, which include Muzaffarabad and Poonch division in the north, Mirpur division in the south. Muzaffarabad division comprises 46 percent of the total area and is divided into three (03) districts. Mirpur division is divided into three districts. The Poonch is divided into four districts. These administrative divisions are shown on **Fig. 2.1**.

The State population is about 4.04 million as per 2017 census, out of which nearly 84 percent resides in the rural areas. A summary of the area and population statistics is given **Table 2.1** below:

Table 2.1: Area and Population Statistics of various Districts of AJ&K as per 2017 censuses

Division	District	Area (km ²)	Pop. (2017)	Headquarter
Muzaffarabad	Muzaffarabad	1642	650,371	Muzaffarabad
	Jhelum Valley	854	230,529	Hattian
	Neelum	3,621	191,251	Athmaqum
Poonch	Bagh	1,368	371,919	Bagh
	Haveli	598	152,124	Forward Kahuta
	Poonch	855	500,571	Rawalakot

	Sudhnuti	569	297,548	Palandri
Mirpur	Bhimber	1,516	420,624	Bhimber
	Kotli	1,862	774,194	Kotli
	Mirpur	1,010	456,200	Mirpur

2.3 Physiography and Infrastructure

Muzaffarabad, the northern division of the State, is dominantly mountainous with intermountain valleys forming the foothills of Himalayas. Mirpur, the southern division, is relatively low relief with broad plains. The elevation gradually varies from 6325 m in the north to 360 m in the south. The winters and summers snow lines are at elevations 1200 and 3300 m respectively.

The State climate is sub-tropical highlands type with an average yearly rainfall of about 1300 mm. The north and north western mountainous areas are extremely cold in winters while the summers are pleasant. The southern regions are relatively cold and dry in winters and extremely hot in summers.

Administrative and civic infra-structure is well developed in the state. The State is approachable from eleven (11) major cities of Pakistan through a well-planned road network. In addition, all the cities and towns within the State are interconnected with fairly constructed roads; having a cumulative length of about 5461 km. A network of major road is shown in **Fig. 2.2**.

2.4 Previous Studies

In year 2001, the Central Design Office (CDO), Government of the AJ&K conceived a two-phase study for construction material sources and preparation of Composite Schedule of Rates. Phase-1 of this study was entrusted to NESPAK with a limited scope and budget. The study was conducted in accordance with the terms of reference and a report was submitted in 2002.

Phase 1 Report provided a fair platform to found Phase 2 study; i.e., the current study. It provided detailed information concerning existing and potential major sources and suggested their usage. The report was thoroughly consulted for planning and executing the current study.

2.5 Common Construction Practices

A variety of construction practices are adopted in the State depending upon the physiographic location, and socio-economic status. Awareness of these practices was considered necessary to assess the requirements of construction material in various regions of the state. A summary of the common practices for construction of buildings is given **Table 2.2**.

Various typical designs for roads are used in the State depending upon their status and traffic statistics. A summary of the common practices for roads are given in Table 2.3.

2.6 Cement Used

There is no cement industry in the State and thus all requirements are met from the cements produced in Pakistan. The type and composition of cement has direct relevance with evaluation of the construction material sources; in view of which, a brief appraisal of the cements brought from Pakistan was also conducted during the present study.

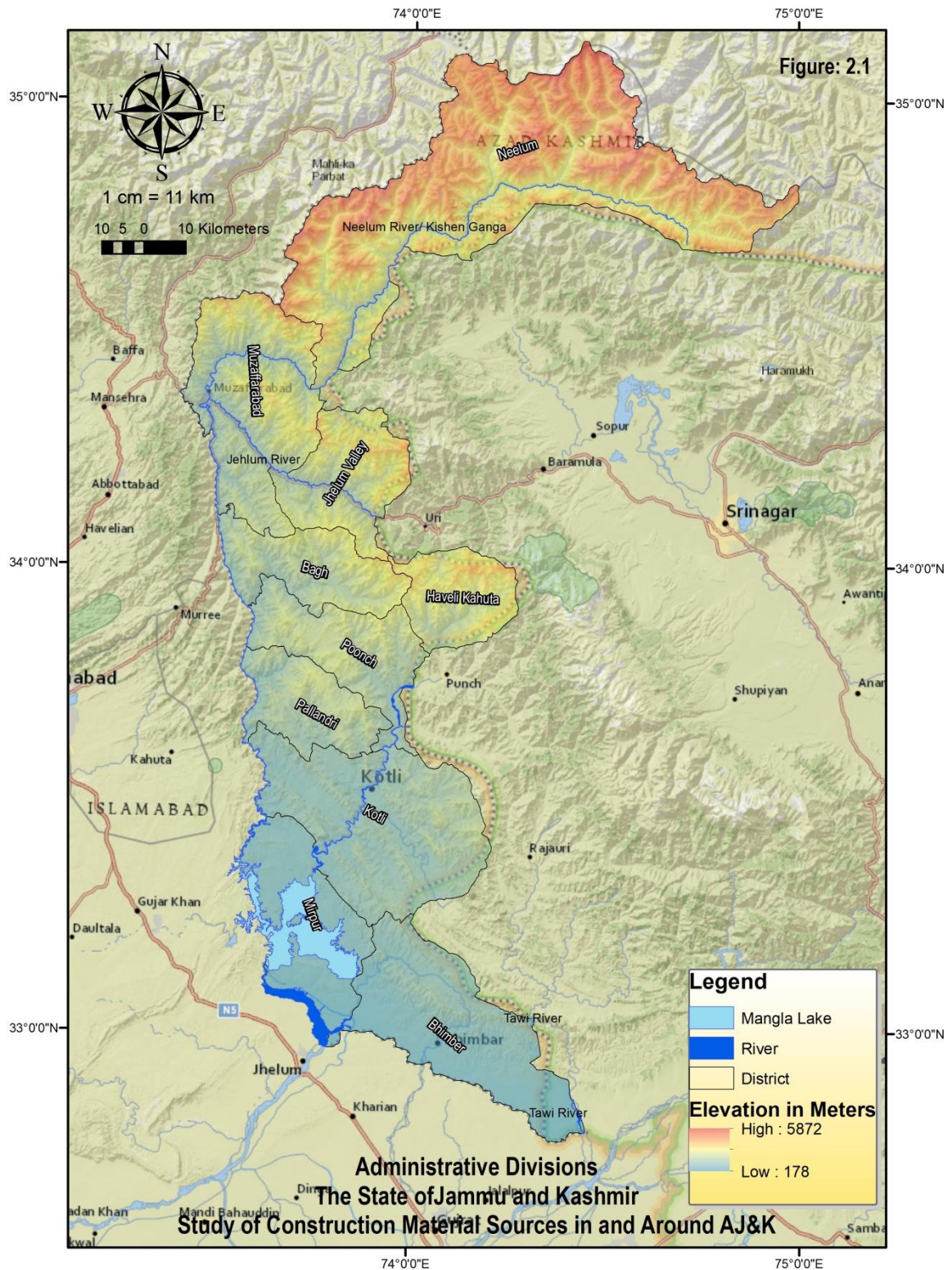


Figure 2.1: Administrative Divisions of Azad Jammu and Kashmir

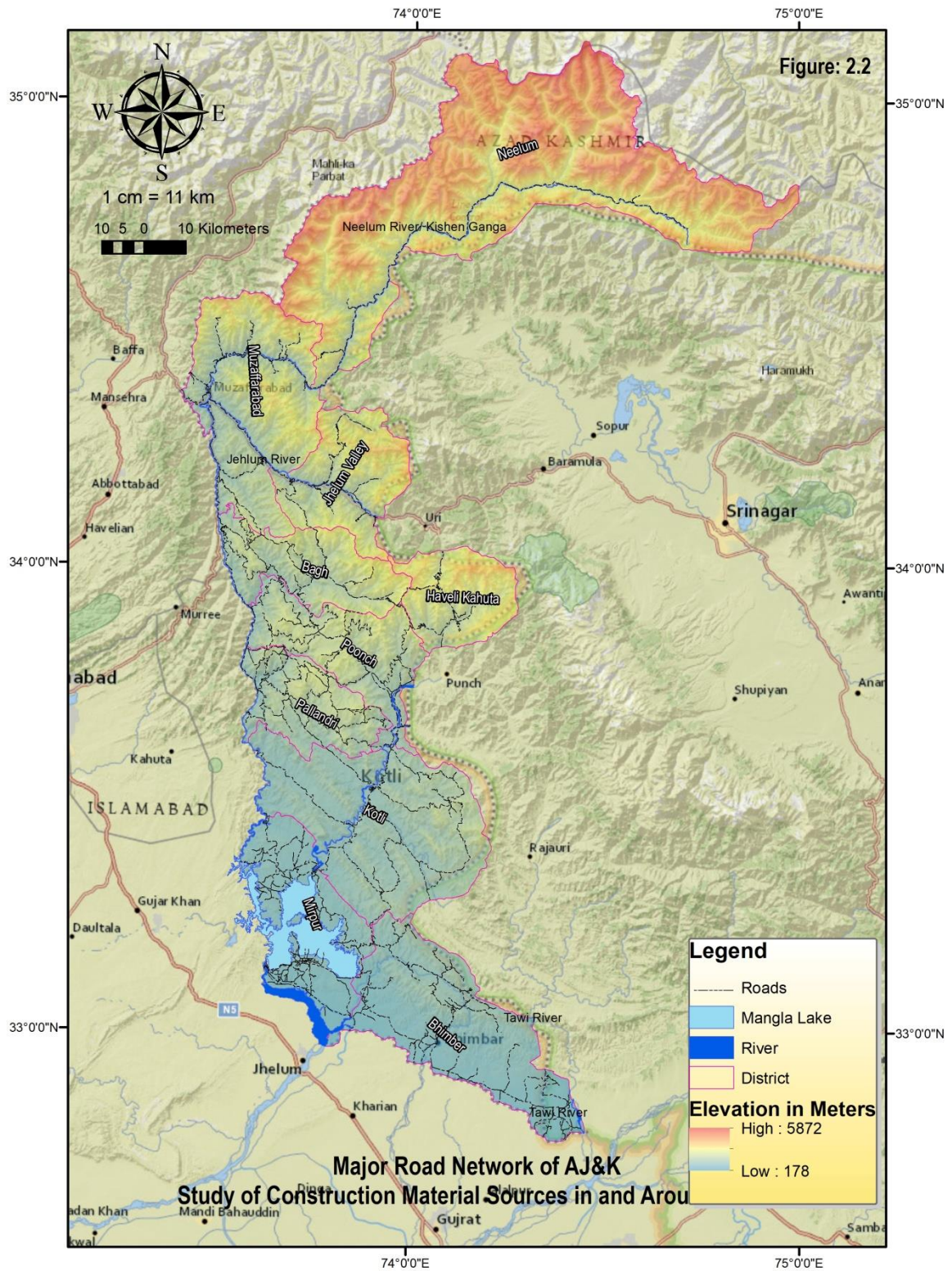


Figure 2.2: Major Road Network Map of Azad Jammu and Kashmir

The appraisal is based on the available technical reports and information provided by the manufacturers. Major findings of the appraisal are discussed in the following section.

TABLE 2.2: Summary of the Common Practices for Buildings

Building Construction Types	Urban		Rural		Remarks
	Private	Public	Private	Public	
Dhaji Buildings	x	x	✓	✓	1
Block Masonry	✓	✓	✓	✓	2
Concrete Pavers	✓	✓	x	x	3
Concrete Frames	✓	✓	✓	✓	4
Stone Masonry	✓	✓	✓	✓	5
Brick Masonry	✓	✓	✓	✓	6
Concrete Walls	✓	✓	x	✓	7

1. Dhaji is the old style of building construction in AJ&K. This style of the construction has lost popularity in urban areas due to increased prices of wood. However, in Neelum Valley beyond the town of Athmaqum it is still a preferred style of construction in private sectors.
2. The block masonry is gaining widespread acceptance after the earthquake of 2005.
3. Concrete pavers are only used in public sector and have limited private use in the urban areas.
4. The concrete columns are the standard construction type for all buildings in earthquake prone areas of AJ&K.
5. The retaining walls, drainage channels and Dhaji construction are the structure which has the consumption of stones.
6. Bricks are used in all districts other than Neelum.
7. Concrete frames are only used in public buildings.

TABLE 2.3: Practices for Construction of Roads in AJ&K

Road Construction Practices		Highways	Inter District Roads	Intra District Roads
Road Elements	Asphalt Layer	✓	✓	✓
	Base/ Sub Base	✓		
	Soling	✓	✓	✓
Embankments	Sub-grade	✓		
Cross Drainage Structures	Bridges	✓	✓	
	Causeways	✓	✓	
	Culverts	✓	✓	✓
Retaining Walls	Concrete Retaining Walls	✓	✓	✓
	Stone Masonry Retaining Walls	✓	✓	✓
	Gabion Walls	✓	✓	✓
Water Conveyance	Stone Masonry Drains	✓	✓	✓
	Concrete Drains	✓	✓	✓

2.6.1 Cement Types and Sources

Pakistan cement industry is well established producing various types of cement for local as well as international market. The cement types produced include Ordinary Portland, Sulphate-Resisting Portland, Portland-Blast Furnace, Low Heat Portland-Blast Furnace, Super Sulphate, and White cement. All these types are produced in accordance with BS Specifications.

Ordinary Portland type constitutes more than 95 percent of the total cement production. These factories are owned by public sector as well as local and foreign private sectors. The industry located in the northern region of Pakistan has over 87 percent share of the total sales. Almost entire cement needs of the State are met from the industry located in the northern region Pakistan.

Chemical compositions and physical properties of the Ordinary Portland Cement (OPC); produced at various factories located in the northern region of Pakistan, are summarized in Table 2.4. These factories generally meet BS 12 Specifications except exceeding the maximum tolerable limit of 0.4% alkalis (Na₂O equivalent) as suggested in ASTM C-150. Some units do meet this limit also at times due to better raw material but the quality is inconsistent. It is assessed that most of the cement used in AJ&K range in alkalis content between 0.5 and 0.8 percent.

Other cement types including (a) Sulphate-Resisting Portland (b) Portland-Blast Furnace, (c) Low Heat Portland-Blast Furnace and (d) Super Sulphate can be produced by the existing units as sub-products depending upon the requirements. White cements are produced by selected units meeting the local requirements. All these cements are also produced as per BS Specifications.

None of the factory produces low alkali cement due to economic and technological factors. However, some factories do express interests in such productions upon surety of specific demands with cost premiums.

2.7 Composite Schedule of Rates (CSR) of 2004

Composite Schedule of Rates (CSR) in AJ&K was also prepared in 2004. The document has recently been updated by NESPAK under the current study, which is titled as CSR 2014. The CSR-2004 recommends the following:

- Margalla quarry, Pakistan is the only approved source for coarse aggregate in the CSR 2014.
- Lawrencepur and Chenab sand deposit, Pakistan are also approved.

However, material from local sources and some sources from adjoining areas are allowed which are not included in the CSR-2004.

The major construction elements produced through this construction material and referred in the CSR include (a) load bearing and non-load bearing concrete blocks, (b) lean concrete, (c) concrete, (d) reinforced and pre-stressed concrete, (e) base and sub base courses, (f) asphalt course and (g) masonry and soling stone.

2.8 Study Related Issues

Based on the review of the above stated base level information important construction material issues were identified to comprehend study planning and methodology. These issues were discussed with the Working Group and findings were used to formulate

realistic approach for the present study. Some of the issues identified in this respect are stated below:

- Concrete durability is adversely affected by expansive reactions between cement alkalis and deleterious minerals in the aggregate. The cements manufactured in Pakistan are high in alkalis, while most of the potential sources for concrete aggregate in AJ&K contain deleterious minerals.

For fear of expansive reactions resulting in loss of concrete durability the local potentially reactive sources have been declared unsuitable rendering the State dependent on sources located in Pakistan. This situation warrants careful examination of the local sources of aggregate with respect to presence of deleterious minerals.

- The material sources recommended in the CSR-2004 are located at a minimum distance of more than 150 km outside the administrative boundaries of AJ&K. Transportation of the material for such large distances cause great burden to the State exchequer.

The sources located in between the CSR recommended sources and State should also be evaluated during the current study to reduce transportation costs.

- Asphalt aggregate are also brought from far off sources located in Pakistan at the same rates as quoted for the concrete coarse aggregate.

The local sources are carefully examined for their suitability as asphalt aggregate.

- There are no recommended sources for masonry stone and base/sub base material for road and construction. The construction needs are met through exploiting local sources and / or project excavations, which at times create slope stability and environmental issues.

All sources identified during the present study should be examined with respect to slope stability and environmental concerns.

CHAPTER 3

EXISTING SOURCES WITHIN TEN DISTRICTS

3.1 General

Pilot study was conducted in the districts of Muzaffarabad, Jhelum Valley, Bagh and Haveli. These districts form the northern part of the State of AJ&K, and represent typical conditions of the areas having construction material difficulties. Moreover, these districts were worst affected by the earthquake of October 2005 and thus require enormous construction material for reconstruction.

Prior to initiating the study for construction material sources in the Pilot Area, a comprehensive appraisal of the prevailing relevant conditions in these districts were assessed. In this regard, physiographic conditions, existing material sources, quarrying/borrowing practices, transport routes and future requirements of the material were assessed. This information; which provided a realistic onset for the Pilot Study, is summarized in this chapter.

The districts of Kotli, Mirpur and Bhimber form the southern part of the State of Azad Jammu and Kashmir, while the districts of Neelum, Poonch and Sudhnuti form the northern and middle part of the State of Azad Jammu and Kashmir respectively.

Before initiating the study for construction material sources in these districts, a comprehensive appraisal of the prevailing relevant conditions was also assessed. In this regard, physiographic conditions, existing material sources, quarrying/borrowing practice and transport routes were also assessed. The information related to these districts Study, are summarized in this chapter.

3.2 Physiography

The Pilot Study area comprises 3864 square kilometers (1492 square mile). Topography of the area is mainly hilly and mountainous with valleys. The main rivers are Jhelum and Neelum in districts Muzaffarabad and Jhelum Valley and Betar, Mahl and Malwani Kas in districts Bagh and Haveli. The climate of the area is sub-tropical highland type with an average yearly rainfall of 1300 mm.

The Southern districts area comprises 4388 square kilometers (1994 square mile). Topography of the area is both hilly and plain in an almost equal proportion. The main rivers are Poonch and Jhelum in Kotli and Mirpur district. The main nullahs drains into these rivers in Kotli and Mirpur districts are Khorbun Nullah, Jeri Kas, Saketar, Kanali Kas, Har Kas, Ganoi Kas and Jatilan. Bhimber Nullah, Panjari Nullah, Dhandar Nullah, Chaprian Nullah, Bhring Nullah, Khadala Nullah, and Samani Nullah in Bhimber district. The climate of the area is sub-tropical highland type with an average yearly rainfall of 1000-1200 mm.

The Neelum district area comprises 3621 square kilometers. Topography of the area is mainly hilly, mountainous with valleys and plains at some places. The main river is Neelum in Neelum district. The climate of the area is sub-tropical highland type with an average yearly rainfall of 1200 - 1300 mm on the average.

About 240 kilometers long the picturesque Neelum Valley is situated to the North and North East of Muzaffarabad, running parallel to the Kaghan valley is separated from it by snow covered peaks, some over 4000 meter above sea level. Excellent scenic beauty,

panoramic view, towering hills on both sides of the noisy Neelum River, lush green forests, enchanting streams. High altitude lakes and attractive surroundings make the valley a dream come true. A fair-weather road opens the valley up to Kel.

The district Poonch area comprises 855 square kilometers. The topography of the area is mainly hilly and mountainous with valleys and stretches of plains. The main river is Poonch River in the district. The climate of the area is sub-tropical highland type with an average yearly rainfall of 1300 mm on the average. Rawalakot the districts headquarter is situated in the heart of the district. The altitude of this beautiful saucer-shaped valley is 1615 meters. Rawalakot is situated at a distance of 76 kilometers from Kohala and 110 km from Rawalpindi. It is linked with Rawalpindi Islamabad via Azad Pattan and Dhalkot and with Muzaffarabad via Kohala by black top roads. The construction of Goi Nullah road between Rawalakot and Azad Pattan has reduced the distance and journey time considerably.

The district Sudhnuti area comprises 569 square kilometers. Topography of the area is mainly hilly, mountainous with valleys and plains. The climate of the area is sub-tropical highland type with an average yearly rainfall of 1200 - 1300 mm on the average. Palandri is the headquarter of district Sudhnuti, it is at an elevation of 1372 meters and is at a distance of 100 kilometers from Rawalpindi via Azad Pattan, and is also connected with Rawalakot by 64 kilometers long road. The climate is pleasant throughout the year. Temperature in summers is almost 20 to 35 °C and in winters 5 to 25 °C.

3.3 District Muzaffarabad

The materials used within district Muzaffarabad are borrowed from various existing sources located in AJ&K and Pakistan. Some relevant details concerning these sources were examined carefully for better understanding of the situation. These details are briefly discussed in the following sections.

3.3.1 Existing Material Sources

The current practices for procurement of construction material were carefully evaluated during the study. Important details relevant to the study are summarized in **Table 3.1**. These details relate to haulage distance, quality of material, approval status with respect to composite schedule of rates, and procurement costs at various tehsils of districts Muzaffarabad and Jhelum Valley. Important findings of the study are briefly stated below:

(a) Sources within District Muzaffarabad

- Coarse aggregates are procured from three (3) sources located within Muzaffarabad city and six (6) sources located outside AJ&K.
- The sources for coarse aggregate located within Muzaffarabad include (a) Yadgar Batmang Limestone, (b) Kamsar Limestone/ Dolomite, and (c) Makri Natural Crush.
- Margalla Limestone exposed at Yadgar was approved and recommended during Phase-1 study. Few new locations of Margalla Limestone are identified at Batmang, Zahid Chowk and Hill Seri Dera localities during this phase; however, it has not yet been fully exploited. Quarry is developed at Yadgar locality, only one crusher is installed near road at this locality. The material is mostly used within Muzaffarabad city.

CONSTRUCTION MATERIAL SOURCES IN AND AROUND AZAD JAMMU & KASHMIR
TABLE 3.1
 Current Practices for Procurement of Construction Materials in District Muzaffarabad

Sr. No.	Source Name	Quality Acceptance	Status with respect to CSR -2004	Contribution of the Source	At Source Cost Including Loading (Rs./CFT)	Estimated Procurement Cost (Rs./CFT)		
						Haulage (Km)	Transportation Cost (Rs.)	Procurement Cost (Rs./CFT)
Sources within Muzaffarabad								
1	Yadgar Batmang Limestone Rock Quarry	Yes	Not Approved	Minor	12.0	7	10.0	22.0
2	Kamsar Limestone/ Dolomite Rock Quarry	No	Not Approved	Moderate	12.0	5	10.0	22.0
3	Makri Natural Crush	No	Not Approved	Moderate	9.5	5	10.0	19.5
4	Neelum River Sand (Chhalpani)	No	Not Approved	Moderate	12.0	15	15.0	27.0
5	Jhelum River Sand (Langarpura, Dulai, Domel, Barsala)	No	Not Approved	Moderate	11.0	10	15.0	26.0
Sources Outside AJ&K Hauled through Barar Kot								
1	Margalla Limestone Rock Quarry (Hatta Taxila)	Yes	Approved	Major	10.0	140	30.0	40.0
2	Rohi Nullah Bed Material (Hatta Taxila)	Conditional	Not Approved	Major	9.0	135	27.0	36.0
3	Dor River Bed Material (Havelian)	Heterogeneous	Not Approved	Minor	8.5	110	22.5	31.0
4	Gummamah Limestone Rock Quarry Nathiagali	Yes	Not Approved	Minor	11.0	86	22.5	33.5
5	Lawrencepur Sand Deposits (Qibla Bandi)	Yes	Approved	Major	7.0	175	25.0	32.0
Sources Outside AJ&K Hauled through Kohala								
1	Margalla Limestone Rock Quarry (Hatta Taxila)	Yes	Approved	Major	10.0	180	30.0	40.0
3	Lora Maqsood Rock Quarry	Yes	Not Approved	Minor	12.0	75	25.0	37.0
4	Lawrencepur Sand Deposits (Qibla Bandi)	Yes	Approved	Major	6.0	215	30.0	36.0

- Kamsar source was rejected during Phase-1 Study; however, after the earthquake of 2005 numerous crushers have been installed in this area. Aggregate from this source are a mix of limestone and dolomite. No quality control procedures are administered at this location. Aggregate are used throughout the district in private construction.
- Material from Makri Naturally Crushed Rock is extensively quarried and used in both districts. This material is relatively cheap as it is used in the natural form with addition of only little percentage of fine aggregate. The material is used mostly in concrete block making. The source was opened after the earthquake of 2005 due to high material demand. However, this source has been a matter of debate due to associated environmental, safety and quality concerns, which is banned by AJ&K Supreme Court in the light of construction material sources study reports of NESPAK.
- Neither Kamsar nor Makri source is recommended in the Composite Schedule of Rates.
- Fine aggregate is extracted from (a) Jhelum riverbed at various places including Langarpura, Chatter Domail, Dulai, and Barsala and (b) from Neelum riverbed at Chhalpani, Muzaffarabad district. These aggregates are used mostly for private construction. These sources are also not approved in the CSR.
- No proper source is specified in CSR for masonry stone and road base/subbase material. These materials are extracted from local sources near the project sites or project excavations.

(b) Sources within AJ&K other than Districts Muzaffarabad

- No material is transported to districts Muzaffarabad from other districts of AJ&K.

(c) Sources outside AJ&K.

- The coarse aggregate sources located outside AJ&K in Pakistan include (a) Margalla Limestone, (b) Rohi Nullahbed material, (c) Dor River bed material, (d) Gummamah Limestone rock quarry (Abbottabad- Nathiagali road), and (e) Lora Maqsood Limestone rock quarry.
- Coarse aggregate from sources located outside AJ&K mostly reach Muzaffarabad through Bararkot due to relatively gentler road gradients. However, some percentage of aggregate from Margalla Limestone and Lora Maqsood Limestone rock quarries also reach Muzaffarabad through Kohala.
- Margalla Limestone and Rohi Nullah bed material are the main sources of coarse aggregate for districts Muzaffarabad and Jhelum Valley.
- Coarse aggregate brought from Margalla Limestone rock quarry and Rohi Nullah bed material is most expensive as being located at farthest distance. A large number of crushers are installed at these sources.
- Coarse aggregate produced from nullah and riverbed material has one face round, which render them as not very attractive for use.
- Margalla Limestone is the only source for coarse aggregate that is approved and recommended in the Composite Schedule of Rates for AJ&K Pakistan.

- Fine aggregate is mostly brought from Lawrencepur, which is suitable for use and is also included in the Composite Schedule of Rates 2004.
- No masonry stone and road base/subbase material are brought from outside AJ&K.

3.3.2 Quarrying/ Borrowing Practices

Current quarrying and borrowing practices at the existing material sources located within districts Muzaffarabad and relevant sources of Pakistan are summarized in **Table 3.2**. Important aspects of the practices being followed within the district as briefly stated below:

- Major quarrying activity is going on at Kamsar Limestone/Dolomite rock quarry, where 15 beater crushers are installed. The aggregate is mostly used within Muzaffarabad district; however, some material is transported to Bagh, Neelum districts as well. The quarry is not approved officially. The aggregate comprises limestone and dolomite. There is no control on the quality of aggregate produced. Full face quarrying with drill/blast method and crow bars is being practiced at this source.
- Only one crusher is recently installed at Yadgar Batmang Margalla Limestone quarry. The material is locally used. Margalla Limestone is also exposed at Hill Seri Dera and Zahid Chowk localities.
- Extensive borrowing is being done at Makri on the left bank of Neelum River near Muzaffarabad. The material is naturally crushed and directly loaded for transportation, and is mostly used in block making and low-cost construction. The quarry face is irregular and unstable and poses hazard to life and machinery during rains or earthquake.
- Fine aggregate (sand) is being borrowed from Neelum river at Chhalpani and Jhelum river at Langarpura, Domel, Thorey, Dulai, Chatter Kalas, and Barsala. Limited quantities of fine aggregate are available at these locations and that too in low flow period. The material is brought to road level through vehicles and winch trolleys and stocked along the road side. It is used mostly in private construction.
- There is no approved material source for masonry stone and road base/sub base in the districts. These are mostly procured from material extracted from excavations during the construction of new road and from hard rock exposures along the existing road.

3.3.3 Outsource Material Transportation Routes

In the absence of any approved material source in district, a considerable fraction of the requirement is met through sources present in Pakistan. The material is transported into district through two routes including (a) Mansehra-Bararkot road and (b) Murree-Kohala road. The former route has relatively milder grade and thus widely adopted by the transporters.

3.4 District Jhelum Valley

The materials used within district Jhelum Valley are borrowed from various existing sources located in AJ&K and Pakistan. Some relevant details concerning these sources were examined carefully for better understanding of the situation. These details are briefly discussed in the following sections.

CONSTRUCTION MATERIAL SOURCES IN AND AROUND AZAD JAMMU & KASHMIR

TABLE 3.2

Current Practices for Procurement of Construction Materials in District Hattian

Sr. No.	Source Name	Quality Acceptance	Status with respect to CSR -2004	Contribution of the Source	At Source Cost Including Loading (Rs./CFT)	Estimated Procurement Cost (Rs./ CFT)		
						Haulage (Km)	Transportation Cost Rs.	Procurement Cost (Rs./CFT)
Sources within Muzaffarabad								
1	Yadgar Batmang Limestone Rock Quarry	Yes	Not Approved	Minor	12.0	51	20.0	32.0
2	Kamsar Limestone/ Dolomite Rock Quarry	No	Not Approved	Moderate	12.0	52	20.0	32.0
3	Makri Natural Crush	No	Not Approved	Moderate	9.5	48	20.0	29.5
4	Neelum River Sand (Chhalpani)	No	Not Approved	Moderate	12.0	54	25.0	37.0
5	Jhelum River Sand (Langarpura, Dulai, Domel, Barsala)	No	Not Approved	Moderate	11.0	20	20.0	31.0
Sources Outside AJ&K Hauled through Barar Kot								
1	Margalla Limestone Rock Quarry (Hatta Taxila)	Yes	Approved	Major	10.0	185	40.0	50.0
2	Rohi Nullah Bed Material (Hatta Taxila)	Conditional	Not Approved	Major	9.0	183	35.0	44.0
3	Dor River Bed Material (Havelian)	Heterogeneous	Not Approved	Minor	8.5	155	32.5	41.0
4	Gummamah Limestone Rock Quarry Nathiagali	Yes	Not Approved	Minor	11.0	131	32.5	43.5
5	Lawrencepur Sand Deposits (Qibla Bandi)	Yes	Approved	Major	7.0	220	35.0	42.0
Sources Outside AJ&K Hauled through Kohala								
1	Margalla Limestone Rock Quarry (Hatta Taxila)	Yes	Approved	Major	10.0	230	40.0	50.0
3	Lora Maqsood Rock Quarry	Yes	Not Approved	Minor	12.0	120	35.0	47.0
4	Lawrencepur Sand Deposits (Qibla Bandi)	Yes	Approved	Major	6.0	260	40.0	46.0

CONSTRUCTION MATERIAL SOURCES IN AND AROUND AZAD JAMMU & KASHMIR

TABLE 3.3

Current Quarrying and Borrowing Practices at the Existing Material Sources located within Pilot Study Area and Relevant Sources of Pakistan

Sr. No.	Source Name	Location	Estimated Quantity			Current Quarrying/ Borrowing Practices							Blasting		Crushing			Screening			Loading			Ownership/Leasing			
			Huge	Limited	Seasonal	Rock Quarry			Stream Bed Gravel Boulders		Stream Bed Sand		Drill & Blast	Crow Bar	Jaw Crushers	Beater Crushers	Crushing Units (Approx. No.)	Trommels	Vibrating Screens	Stationary Screens	Manual	Mechanical	Conveyor Belts	Public/ Leased	Public/Unleased	Private	
						Bench & Shelf Method	Full Face Method	Ripping	Hand Picking	Shovel	Bulk Excavation	Digging															Digging and Screening
ROCK QUARRIES																											
1	Yadgar Batmang Limestone Rock Quarry	Muzaffarabad District	✓				✓							✓			✓	1	✓			✓		✓			
2	Kamsar Limestone/ Dolomite Rock Quarry	Muzaffarabad District												✓	✓			✓	13	✓			✓	✓		✓	
3	Margalla Limestone Rock Quarry	Taxila, Pakistan	✓				✓							✓		✓		✓	150		✓	✓		✓	✓	✓	
4	Gummamah Limestone Rock Quarry	Abbottabad District, Pakistan	✓				✓							✓				✓	10	✓	✓			✓	✓		✓
5	Lora Maqsood Rock Quarry	Abbottabad District, Pakistan	✓				✓							✓		✓		✓	7		✓	✓		✓	✓		✓
NATURAL ROCK CRUSH																											
1	Makri Natural Crush	Muzaffarabad District		✓																			✓		✓		
RIVER AND STREAM BED MATERIAL																											
1	Mahl River Bed Material	Bagh, AJ&K	✓						✓									✓	6	✓	✓		✓	✓			✓
2	Malwani Kas Bed Material	Bagh, AJ&K	✓						✓									✓	3	✓	✓		✓	✓			✓
3	Palangi Nullah Bed Material	Bagh, AJ&K	✓						✓									✓	6	✓			✓				✓
4	Betar Nullah Bed Material	Bagh, AJ&K	✓						✓			✓						✓	2	✓			✓				✓
5	Rohi Nullah Bed Material	Hatta Taxila, Pakistan	✓							✓								✓	50		✓	✓		✓	✓	✓	
6	Dor River Bed Material	Havelian, Pakistan	✓							✓						✓		✓	15		✓			✓	✓	✓	
NATURAL AND CRUSHED SAND																											
1	Neelum River Sand (Chhalpani)	Muzaffarabad District			✓							✓											✓				✓
2	Jhelum River Sand (Langarpura, Dulai, Domel, Barsala)	Muzaffarabad District			✓						✓	✓											✓				✓
3	Lawrencepur Sand Deposits	Qibla Bandi, Pakistan	✓								✓													✓		✓	
4	Mahl River / Malwani Kas Crushed Sand	Bagh, AJ&K		✓														✓	✓			✓	✓				✓
5	Palangai Nullah / Betar Nullah Crushed Sand	Bagh, AJ&K		✓														✓	✓			✓					✓

3.4.1 Existing Material Sources

The current practices for procurement of construction material were carefully evaluated during the study. Important details relevant to the study are summarized in **Table 3.3**. These details relate to haulage distance, quality of material, approval status with respect to composite schedule of rates, and procurement costs at various tehsils of district Jhelum Valley. Important findings of the study are briefly stated below:

(a) Sources within District Jhelum Valley

- Currently, no active quarry for coarse aggregate is operational in district Jhelum Valley.
- Coarse aggregates are procured from three (3) sources located within Muzaffarabad city and six (6) sources located outside AJ&K.
- The sources for coarse aggregate located within Muzaffarabad include (a) Yadgar Batmang Limestone, (b) Kamsar Limestone/ Dolomite, and (c) Makri Natural Crush.
- High strength Dolerite is exposed on the Leepa Valley road near Lamnian and on Cham road near Chakhama which are high strength construction material, however, no quarrying is observed. Similarly, for low rife risk construction compact Murre sandstone in exposed throughout the Jhelum Valley district but material is being imported from Muzaffarabad.
- Fine aggregate is extracted from (a) Jhelum riverbed at various places including Chinari, Hattian Bala and different nullah for local use.
- No proper source is specified in CSR for masonry stone and road base/subbase material. These materials are extracted from local sources near the project sites or project excavations.

(b) Sources within AJ&K other than Districts Jhelum Valley

- Material is transported to district Jhelum Valley from district Muzaffarabad.

(c) Sources outside AJ&K.

- The coarse aggregate sources located outside AJ&K in Pakistan include (a) Margalla Limestone, (b) Rohi Nullahbed material, (c) Dor River bed material, (d) Gummamah Limestone rock quarry (Abbottabad- Nathiagali road), and (e) Lora Maqsood Limestone rock quarry.
- Coarse aggregate from sources located outside AJ&K mostly reach Muzaffarabad through Bararkot due to relatively gentler road gradients. However, some percentage of aggregate from Margalla Limestone and Lora Maqsood Limestone rock quarries also reach Muzaffarabad through Kohala.
- Margalla Limestone and Rohi Nullah bed material are the main sources of coarse aggregate for districts Muzaffarabad and Jhelum Valley.
- Coarse aggregate brought from Margalla Limestone rock quarry and Rohi Nullah bed material is most expensive as being located at farthest distance. A large number of crushers are installed at these sources.
- Coarse aggregate produced from nullah and riverbed material has one face round, which render them as not very attractive for use.

- Margalla Limestone is the only source for coarse aggregate that is approved and recommended in the Composite Schedule of Rates for AJ&K Pakistan.
- Fine aggregate is mostly brought from Lawrencepur, which is suitable for use and is also included in the Composite Schedule of Rates 2004.
- All these outside AJ&K materials are transported to Hattian through retailers from Muzaffarabad as well as local retailers.
- No masonry stone and road base/subbase material are brought from outside AJ&K.

3.4.2 Quarrying/ Borrowing Practices

Current quarrying and borrowing practices at the existing material sources located within district Muzaffarabad and relevant sources of Pakistan are summarized in **Table 3.2**. Important aspects of the practices being followed within the district as briefly stated below:

- No quarry is operational in the district Jhelum Valley.
- Fine aggregate (sand) is being borrowed from Neelum river at Chhalpani and Jhelum river at Langarpura, Domel, Thorey, Dulai, Chatter Kalas, and Barsala. Limited quantities of fine aggregate are available at these locations and that too in low flow period. The material is brought to road level through vehicles and winch trolleys and stocked along the road side. It is used mostly in private construction.
- There is no approved material source for masonry stone and road base/sub base in the districts. These are mostly procured from material extracted from excavations during the construction of new road and from hard rock exposures along the existing road.

3.4.3 Outsource Material Transportation Routes

In the absence of any approved material source in district, a considerable fraction of the requirement is met through sources present in Pakistan. The material is transported into district through two routes including (a) Mansehra-Bararkot road and (b) Murree-Kohala road. The former route has relatively milder grade and thus widely adopted by the transporters.

3.5 District Bagh

The materials used within districts Bagh are brought from various existing sources in AJ&K and Pakistan. Some relevant details concerning these sources were examined carefully for better understanding of the situation. These details are briefly discussed in the following sections.

3.5.1 Existing Material Sources

The current practices for procurement of construction material were carefully evaluated during the study. Important details relevant to the study are summarized in **Table 3.4**. These details relate to haulage distance, quality of material, approval status with respect to Composite Schedule of Rates, and procurement costs at various tehsils of districts Bagh. Important findings of the study are briefly stated below:

(a) Sources within District Bagh

- 1 No suitable source of coarse aggregate is present in Dhirkot and Bagh tehsils. However, some local needs are met through crushing sandstone boulders of Mahl and Malwani

CONSTRUCTION MATERIAL SOURCES IN AND AROUND AZAD JAMMU & KASHMIR TABLE 3.4

Current Practices for Procurement of Construction Materials in District Bagh

Sr. No.	Source Name	Quality Acceptance	Status with respect to CSR - 2004	Contribution of the Source	Including Loading	Estimated Procurement Cost (Rs/CFT)					
						Dhirkot Tehsil			Bagh Tehsil		
						Haulage (Km)	Transportation Cost (Rs/CFT)	Procurement Cost (Rs/CFT)	Haulage (Km)	Transportation Cost (Rs/CFT)	Procurement Cost (Rs/CFT)
Sources within Bagh and Dhirkot Tehsil AJ&K											
1	Mahl River Bed Material (Dhirkot and Bagh)	Yes	Not Approved	Minor	16.0	18	20.0	36.0		15.0	31.0
2	Malwani Kas Bed Material (Bagh)	No	Not Approved	Moderate	16.0					15.0	31.0
3	Mahl River / Malwani Kas Crushed Sand (Dhirkot and Bagh)	No		Moderate	10.0		20.0	30.0		15.0	25.0
Sources within AJ&K and Hauled through Kohala to Dhirkot and Bagh Tehsils											
1	Kamsar Limestone/ Dolomite	No	Not Approved	Moderate	12.0	63	25.0	37.0	103	35.0	47.0
Sources Outside AJ&K Hauled through Kohala to Dhirkot and Bagh Tehsils											
1	Margalla Limestone Rock Quarry (Hatta Taxila)	Yes	Approved	Major	10.0	175	40.0	50.0	210	50.0	60.0
2	Lora Maqsood Rock Quarry	Not Studied	Not Approved	Minor	12.0	70	33.0	45.0	105	50.0	62.0
3	Lawrencepur Sand Deposits (Qibla Bandi)	Yes	Approved	Major	6.0	215	30.0	36.0	245	40.0	46.0
Sources Outside AJ&K Hauled through Tain Dalkot to Bagh Tehsil											
1	Margalla Limestone Rock Quarry (Hatta Taxila)	Yes	Approved	Major	10.0	180	45.0	55.0	180	45.0	55.0
2	Lawrencepur Sand Deposits (Qibla Bandi)	Yes	Approved	Major	6.0	252	39.0	45.0	250	39.0	45.0

Kas rivers. Pan material or crushed sand produced during crushing of nullah bed material is also locally used. These sources are not recommended in the CSR due to quality concerns.

- 2 Fine aggregate is extracted from Mahl River at various places. These aggregates are used mostly for private construction, despite quality concerns. None of the above aggregate sources are recommended in the Composite Schedule of Rates.
- 3 No proper source is specified for masonry stone and road base/subbase material. These materials are extracted from local sources near the project sites or project excavations
 - (b) Sources within AJ&K other than Districts Bagh Coarse aggregate are supplied to Bagh and Dhirkot tehsils from Kamsar Limestone/Dolomite source located in Muzaffarabad city. The material is transported through Kohala. Aggregate from this source are a mix of limestone and dolomite. No quality control procedures are administered at this location.
- 4 The source is not recommended in the Composite Schedule of Rates.
 - (c) Sources outside AJ&K
- 5 The coarse aggregate sources located outside AJ&K include (a) Margalla Limestone, and (b) Lora Maqsood Limestone.
- 6 Coarse aggregate from Margalla Limestone rock quarry are hauled to Bagh through Kohala as well as Tain Dhalkot routes. This material is also transported to Haveli tehsil (Forward Kahuta) through Azad Pattan.
- 7 Coarse aggregate from Lora Maqsood Limestone rock quarry is hauled to Bagh and Dhirkot tehsils through Murree-Kohala route.
- 8 Margalla Limestone is the only source for coarse aggregate that is approved and recommended in the Composite Schedule of Rates for AJ&K.
- 9 Fine aggregate is mostly brought from Lawrencepur, which is suitable for use and is recommended in the Composite Schedule of Rates.
- 10 No masonry stone and road base/subbase material are brought from outside AJ&K.

3.5.2 Quarrying/ Borrowing Practices

Current quarrying and borrowing practices at the existing material sources located within district Bagh and relevant sources of Pakistan are summarized on Table 3.2. Important aspects of the practices being followed within the district are briefly stated below:

- 1 No rock quarry is operative in district.
- 2 Considerable quantities of aggregate are produced from the gravel and boulders of Mahl River and Malwani Kas. The gravel and boulders are mostly handpicked and crushed for coarse and fine aggregate. The material produced mainly used within Dhirkot and Bagh. The material crushed generally comprise of sandstone. About nine (9) beater crushers are installed within these streams at different locations. The sources are unapproved yet.
- 3 There is no approved material source for masonry stone and road base/sub base in district. These are mostly extracted from excavations along the proposed as well as existing roads.

3.5.3 Outsource Material Transportation Routes

In the absence of any approved material source in district, a considerable fraction of the requirement is met through sources located in district Muzaffarabad and Pakistan.

Dhir kot and Bagh receive material from district Muzaffarabad through Kohala route. The material from Pakistan is transported through Kohala and Tain Dhalkot route; the latter is more favorite due to relatively smooth grades for Bagh tehsil.

3.5.4 Future Requirements of Construction Material

On the basis of current construction magnitude and the construction plan for years to come through information collected from various offices in AJ&K and also from Pakistan, the estimated quantities of various constructions material required in private and public sectors of districts Muzaffarabad and Jhelum Valley, Bagh and Haveli are given in Tables 3.4 and 3.5 respectively.

3.6 District Haveli

The materials used within districts Haveli are brought from various existing sources in AJ&K and Pakistan. Some relevant details concerning these sources were examined carefully for better understanding of the situation. These details are briefly discussed in the following sections.

3.6.1 Existing Material Sources

The current practices for procurement of construction material were carefully evaluated during the study. Important details relevant to the study are summarized in **Table 3.5**. These details relate to haulage distance, quality of material, approval status with respect to Composite Schedule of Rates, and procurement costs at various tehsils of district Haveli. Important findings of the study are briefly stated below:

(a) Sources within District Haveli (b) Sources within AJ&K other than Districts Haveli of Coarse aggregate are not supplied to district Haveli. (c) Sources outside AJ&K

- 1 Coarse aggregate is produced from Palangi and Betar nullah beds in Haveli tehsil and are only used locally. Transporters are reluctant to haul these aggregates to Bagh and Dhir kot tehsils due to steep road gradients and high altitudes in between. Pan material or crushed sand produced during crushing of nullah bed material is also locally used. All these aggregates do not meet quality requirements.
- 2 Fine aggregate is extracted from Bettar and Pallangi Nullah at various places. These aggregates are used mostly for private construction, despite quality concerns.
- 3 Limited quantities of aggregate are produced from the gravel and boulders of Palangai and Betar nullah beds. The gravel and boulders are handpicked and crushed for coarse and fine aggregate. The material produced is mainly used within Haveli district. The material crushed generally comprise of sandstone, while limestone and volcanic rocks are left aside. About eight (8) beater crushers are installed within these streams at different locations. The sources are unapproved yet.
- 4 None of the above aggregate sources are recommended in the Composite Schedule of Rates.
- 5 No proper source is specified for masonry stone and road base/subbase material. These materials are extracted from local sources near the project sites or project excavations

CONSTRUCTION MATERIAL SOURCES IN AND AROUND AZAD JAMMU & KASHMIR

TABLE 3.5

Current Practices for Procurement of Construction Materials in District Haveli

Sr. No.	Source Name	Quality Acceptance	Status with respect to CSR -2004	Contribution of the Source	At Source Cost Including Loading (Rs./CFT)	Estimated Procurement Cost (Rs/CFT)		
						Haveli Tehsil		
						Haulage (Km)	Transportation Cost (Rs/CFT)	Procurement Cost (Rs/CFT)
Sources within District Haveli (Forward Kahuta) AJ&K								
1	Palangi Nullah Bed Material	Yes	Approved	Major	14.0		16.0	30.0
2	Betar Nullah Bed Material	Heterogeneous	Not Approved	Major	14.0		16.0	30.0
3	Palangai Nullah / Betar Nullah Crushed Sand	Heterogeneous	Not Approved	Major	10.0		16.0	26.0
3	Lawrencepur Sand Deposits (Qibla Bandi)	Yes	Approved	Major	6.0	245	40.0	46.0
Sources Outside AJ&K Hauled through Azad Pattan to District Haveli (Forward Kahuta)								
1	Margalla Limestone (Hatta Taxila)	Yes	Approved	Major	10.0		50.0	60.0
2	Lawrencepur Sand Deposits (Qibla Bandi)	Yes	Approved	Major	6.0		59.0	65.0

- 6 The coarse aggregate sources located outside AJ&K include (a) Margalla Limestone, and (b) Lora Maqsood Limestone.
- 7 Margalla Limestone is the only source for coarse aggregate that is approved and recommended in the Composite Schedule of Rates for AJ&K.
- 8 Fine aggregate is mostly brought from Lawrencepur, which is suitable for use and is recommended in the Composite Schedule of Rates.
- 9 Haveli district receives material from Margalla Limestone and Lawrencepur Sand quarries located in Pakistan, through Azad Pattan road.
- 10 No masonry stone and road base/subbase material are brought from outside AJ&K.

3.6.2 Quarrying/ Borrowing Practices

Current quarrying and borrowing practices at the existing material sources located within district Haveli and relevant sources of Pakistan are summarized on Table 3.2. Important aspects of the practices being followed within the district are briefly stated below:

- 1 No rock quarry is operative in district Haveli.
- 2 Considerable quantities of aggregate are produced from the gravel and boulders of Bettar and Palangi Nullah. The gravel and boulders are mostly handpicked and crushed for coarse and fine aggregate. The material produced mainly used within District Haveli. The material crushed generally comprise of sandstone. About 4 beater crushers are installed within these streams at different locations. The sources are unapproved yet.
- 3 There is no approved material source for masonry stone and road base/sub base in district. These are mostly extracted from excavations along the proposed as well as existing roads.

3.6.3 Outsource Material Transportation Routes

In the absence of any active quarry of approved material, a considerable fraction of the requirement is met through sources located in district Muzaffarabad and Pakistan. However, the access to district Haveli is through Lassdanna with relatively high grade hence problems are faced in material transportation. It is recommended to install a quarry at Khurshidabad Limestone source to cope out the high strength material demand of district Haveli

3.6.4 Future Requirements of Construction Material

On the basis of current construction magnitude and the construction plan for years to come through information collected from various offices in AJ&K and also from Pakistan, the estimated quantities of various constructions material required in private and public sectors of districts Muzaffarabad and Jhelum Valley, Bagh and Haveli are given in Tables 3.4 and 3.5 respectively.

3.7 District Kotli

The material used within Kotli district is borrowed from various existing sources located in AJ&K and Pakistan. Some relevant details concerning these sources were examined carefully for better understanding of the situation. These details are briefly discussed in the following sections. The current practices for procurement of construction material were carefully evaluated during the study. Important details relevant to the study are

CONSTRUCTION MATERIAL SOURCES IN AND AROUND AZAD JAMMU & KASHMIR

Table 3.6

Estimated Material Requirements for Districts Muzaffarabad

Estimated Construction Requirement			Unit Requirements of Various Materials (m ³)					Estimated Material Requirement (x 10 ⁶ m ³)				
			Fine Aggregate	Coarse Aggregate	Asphalt Aggregate Per Km	Base/ Sub Base Per Km	Stone Per Km	Fine Aggregate	Coarse Aggregate	Asphalt Aggregate	Base/ Sub Base	Stone
A	Private Buildings (No.)											
A1	Rural Buildings (No.)	84,000	50	40				4.2	3.4			
A2	Urban Buildings (No.)	35,000	100	60				3.5	2.1			
B	Public Buildings (No.)											
A1	Small Size Structures (No.)	420	225	58				0.1	0.02			
A2	Large Size Structures (No.)	280	425	115				0.1	0.03			
C	Roads (km)											
C1	Inter-district Roads (km)	70			1066	2485				0.07	0.17	
C2	Link Roads (km)	350			664	2485				0.23	0.87	
C3	Community Roads (km)	1,750			664	2485				1.162	4.34875	
D	Cross Drainage Structures (No.)											
D1	Bridges 100 m span	8	400	600				0.003	0.005			
D2	Causeways @ 1 per 10 km road length of type C1 and C2	147	10	20		10		0.001	0.003			
D3	Culverts @ 2 per km road length	735	8	5				0.006	0.004			
E	Walls (km) (Average Height 3 m)											
E1	Retaining Walls @ 100 m per km road length	126	40	60		350		0.007	0.011			0.0441
E2	Breast Walls @ 200 m per km road length	301	100	150		650		0.018	0.027			0.19565
	TOTAL							7.9	5.6	1.5	5.4	0.2

summarized in **Table 3.6**. These details relate to haulage distance, quality of material, approval status with respect to Composite Schedule of Rates, and procurement costs at various tehsils of southern districts. Important findings of the study are briefly stated below:

(a) Sources within District Kotli

- 1 Coarse aggregate from bedrock and riverbed are procured from twenty-one (21) localities within district Kotli. These sources are located (a) Tatta Pani-Kotli Anticline, (b) Khui-Rata Anticline (c) Poonch river and Tributaries d) Terrace Deposits and e) Murree Sandstone, Tatta Pani.
- 2 The aggregate from these sources are being used in private construction as none of the source is recommended in the Composite Schedule of Rates.
- 3 No source of fine aggregate is available within the district. The sand is procured from Chenab river and Lawrencepur. Both sources are approved in the Composite Schedule of Rates.
- 4 On a very small scale the sand is being procured from sandbars of Poonch River for private construction.
- 5 No proper source is specified in CSR for masonry stone and road base/subbase material. These materials are extracted from local sources near the project sites or project excavations

(b) Sources within AJ&K other than District Kotli

- 6 Riverbed material comprising sandstone is transported to district Kotli from Hajira, district Poonch.

(c) Sources outside AJ&K

- 7 The coarse aggregate both for cement and asphalt concrete located outside AJ&K in Pakistan include only the Margalla Limestone.
- 8 Coarse aggregate from this source mostly reach Kotli through Kahuta-Gulpur road.
- 9 Margalla Limestone is the only source for coarse aggregate that is approved and recommended in the Composite Schedule of Rates of AJ&K.
- 10 Fine aggregate is mostly brought from Lawrencepur, which is suitable for use and is also included in the Composite Schedule of Rates. The other source is Chenab Sand.
- 11 No masonry stone and road base/subbase material are brought from outside AJ&K.

3.8 District Mirpur

The material used within district Mirpur are borrowed from various existing sources located in AJ&K and Pakistan. Some relevant details concerning these sources were examined carefully for better understanding of the situation. These details are briefly discussed in the following sections.

The current practices for procurement of construction material were carefully evaluated during the study. Important details relevant to the study are summarized in **Table 3.7**. These details relate to haulage distance, quality of material, approval status with respect to Composite Schedule of Rates, and procurement costs at various tehsils of district Mirpur. Important findings of the study are briefly stated below:

CONSTRUCTION MATERIAL SOURCES IN AND AROUND AZAD JAMMU & KASHMIR

Table 3.7

Estimated Material Requirements for District Jhelum Valley

Estimated Construction Requirement			Unit Requirements of Various Materials (m ³)					Estimated Material Requirement (x 10 ⁶ m ³)				
			Fine Aggregate	Coarse Aggregate	Asphalt Aggregate Per Km	Base/Sub Base Per Km	Stone Per Km	Fine Aggregate	Coarse Aggregate	Asphalt Aggregate	Base/Sub Base	Stone
A Private Buildings (No.)												
A1	Rural Buildings (No.)	36,000	50	40				1.8	1.4			
A2	Urban Buildings (No.)	15,000	100	60				1.5	0.9			
B Public Buildings (No.)												
A1	Small Size Structures (No.)	180	225	58				0.0	0.01			
A2	Large Size Structures (No.)	120	425	115				0.1	0.01			
C Roads (km)												
C1	Inter-district Roads (km)	30			1066	2485				0.03	0.07	
C2	Link Roads (km)	150			664	2485				0.10	0.37	
C3	Community Roads (km)	750			664	2485				0.498	1.86375	
D Cross Drainage Structures (No.)												
D1	Bridges 100 m span	2	400	600				0.001	0.001			
D2	Causeways @ 1 per 10 km road length of type C1 and C2	30	10	20		10		0.000	0.001			
D3	Culverts @ 2 per km road length	135	8	5				0.001	0.001			
E Walls (km) (Average Height 3 m)												
E1	Retaining Walls @ 100 m per km road length	54	40	60		350		0.007	0.011			0.0189
E2	Breast Walls @ 200 m per km road length	56	100	150		650		0.018	0.027			0.03627
TOTAL								3.4	2.4	0.6	2.3	0.1

(a) Sources within District Mirpur

- 1 Coarse aggregate from riverbed are procured from ten (10) localities within three sources. The sources are located (a) Tributaries of Jhelum River, (b) Poonch River bed and (c) Poonch River Terrace Deposits.
- 2 The aggregate from these sources are being used in the private construction as none of the source is recommended in the Composite Schedule of Rates.
- 3 The Jatilan Nullah bed sand is huge source of medium to fine sand. The source is extensive but is only used in private construction.
- 4 No source of good quality fine aggregate is available within the district. The sand is procured from Chenab River and Lawrencepur. Both sources are approved in the Composite Schedule of Rates.
- 5 No proper source is specified in CSR for masonry stone and road base/subbase material. These materials are extracted from local sources near the project sites or project excavations

(b) Sources within AJ&K other than District Mirpur

- 1 No material is transported to district Mirpur from other districts of AJ&K.

(c) Sources outside AJ&K

- 1 The coarse aggregate both for cement and asphalt concrete located outside AJ&K include the Margalla Limestone and Chak Daulat near Jhelum City.
- 2 Coarse aggregate from these sources mostly reach Mirpur through GT Road Dina - Mangla.
- 3 Margalla Limestone is the only source for coarse aggregate that is approved and recommended in the Composite Schedule of Rates of AJ&K.
- 4 Fine aggregate is mostly brought from Lawrencepur, which is suitable for use and is also included in the Composite Schedule of Rates. Chenab sand is also transported to district Mirpur.
- 5 No masonry stone and road base/ subbase material are brought from outside AJ&K.

3.9 District Bhimber

The material used within Bhimber district is borrowed from various existing sources located in AJ&K and Pakistan. Some relevant details concerning these sources were examined carefully for better understanding of the situation. These details are briefly discussed in the following sections.

The current practices for procurement of construction material were carefully evaluated during the study. Important details relevant to the study are summarized in **Table 3.8**. These details relate to haulage distance, quality of material, approval status with respect to composite schedule of rates, and procurement costs at various tehsils of district Bhimber. Important findings of the study are briefly stated below:

(a) Sources within District Bhimber

- 1 Coarse aggregate from riverbed are procured from three (03) localities within the district. The sources are located a) Dandarkot, b) Panjari and c) Chaprian.

CONSTRUCTION MATERIAL SOURCES IN AND AROUND AZAD JAMMU & KASHMIR

Table 3.8

Estimated Material Requirements for District Bagh

Estimated Construction Requirement			Unit Requirements of Various Materials (m ³)					Estimated Material Requirement (x 10 ⁶ m ³)					
			Fine Aggregate	Coarse Aggregate	Asphalt Aggregate Per Km	Base/ Sub Base Per Km	Stone/ Per Km	Fine Aggregate	Coarse Aggregate	Asphalt Aggregate	Base/ Sub Base	Stone	
A	Private Buildings (No.)												
A1	Rural Buildings (No.)	65,000	50	40				3.25	2.6				
A2	Urban Buildings (No.)	26,000	100	60				2.6	1.6				
B	Public Buildings (No.)												
A1	Small Size Structures (No.)	205	225	58				0.0	0.01				
A2	Large Size Structures (No.)	325	425	115				0.1	0.04				
C	Roads (km)												
C1	Inter-district Roads (km)	65			1066	2485				0.07	0.16		
C2	Link Roads (km)	295			664	2485				0.20	0.73		
C3	Community Roads (km)	1,300			664	2485				0.8632	3.2305		
D	Cross Drainage Structures (No.)												
D1	Bridges 100 m span	5	400	600				0.002	0.003				
D2	Causeways @ 1 per 10 km road length of type C1 and C2	159.5	10	20		10		0.002	0.003				
D3	Culverts @ 2 per km road length	797.5	8	5				0.006	0.004				
E	Walls (km) (Average Height 3 m)												
E1	Retaining Walls @ 100 m per km road length	117	40	60		350		0.007	0.011				0.04095
E2	Breast Walls @ 200 m per km road length	332	100	150		650		0.018	0.027				0.2158
	TOTAL							6.1	4.3	1.13	4.1		0.25675

- 2 The aggregate from these sources are being used in the private construction as none of the source is recommended in the Composite Schedule of Rates.
- 3 Few marginal sources of fine aggregate are available within the district.
- 4 The sand is also procured from Chenab River and Lawrencepur. Both sources are approved in the Composite Schedule of Rates.
- 5 No proper source is specified in CSR for masonry stone and road base/subbase material. These materials are extracted from local sources.

(b) Sources within AJ&K other than District Bhimber

- 6 No material is transported in Bhimber from other districts.

(c) Sources outside AJ&K

- 7 The coarse aggregate both for cement and asphalt concrete located outside AJ&K in Pakistan include only the Margalla Limestone.
- 8 Coarse aggregate from this source mostly reach Bhimber through GT road.
- 9 Margalla Limestone is the only source for coarse aggregate that is approved and recommended in the Composite Schedule of Rates for AJ&K.
- 10 Fine aggregate is mostly brought from Lawrencepur, which is suitable for use and is also included in the Composite Schedule of Rates.

No masonry stone and road base/subbase material are brought from outside.

3.10 Quarrying/ Borrowing Practices in Districts Kotli, Mirpur and Bhimber

Current quarrying and borrowing practices at the existing material sources located within Kotli, Mirpur and Bhimber districts and relevant sources of Pakistan are summarized in **Table 3.9**. Important aspects of the practices being followed within the districts as briefly stated below:

- 1 Major quarrying activity is going on Poonch River gravel source, where 14 beater crushers are installed. The aggregate is mostly used within Kotli and Mirpur districts; however, some material is transported to Bhimber district as well. The aggregate comprises limestone, dolomite, quartzite and sandstone.
- 2 The hard rock quarries are only established in Kotli area, in Tatta Pani- Sawar and Goi Nikial area. There is no control on the quality of aggregate produced. Full face quarrying with drill/blast method and crow bars is being practiced at this source.
- 3 No hard rock quarry is located in district Mirpur.
- 4 No commercial scale borrowing of sand is in operation in these three districts.
- 5 There is no approved material source for masonry stone and road base/sub base in the district. These are mostly extracted from excavations along the proposed as well as existing roads.

3.11 District Neelum

The material used within Neelum district is borrowed from various existing sources located in AJ&K and Pakistan. Some relevant details concerning these sources were

CONSTRUCTION MATERIAL SOURCES IN AND AROUND AZAD JAMMU & KASHMIR												
Table 3.9												
Estimated Material Requirements for District Haveli												
Estimated Construction Requirement		Unit Requirements of Various Materials (m ³)						Estimated Material Requirement (x 10 ⁶ m ³)				
		Fine Aggregate	Coarse Aggregate	Asphalt Aggregate Per Km	Base/Sub Base Per Km	Stone/Per Km	Fine Aggregate	Coarse Aggregate	Asphalt Aggregate	Base/Sub Base	Stone	
A	Private Buildings (No.)											
A1	Rural Buildings (No.)	35,000	50	40				1.75	1.4			
A2	Urban Buildings (No.)	14,000	100	60				1.4	0.8			
B	Public Buildings (No.)											
A1	Small Size Structures (No.)	105	225	58				0.0	0.01			
A2	Large Size Structures (No.)	175	425	115				0.1	0.02			
C	Roads (km)											
C1	Inter-district Roads (km)	35			1066	2485				0.04	0.09	
C2	Link Roads (km)	105			664	2485				0.07	0.26	
C3	Community Roads (km)	700			664	2485				0.4648	1.7395	
D	Cross Drainage Structures (No.)											
D1	Bridges 100 m span	2	400	600				0.001	0.001			
D2	Causeways @ 1 per 10 km road length of type C1 and C2	80.5	10	20			10	0.001	0.002			
D3	Culverts @ 2 per km road length	402.5	8	5				0.003	0.002			
E	Walls (km) (Average Height 3 m)											
E1	Retaining Walls @ 100 m per km road length	63	40	60			350	0.007	0.011			0.02205
E2	Breast Walls @ 200 m per km road length	168	100	150			650	0.018	0.027			0.1092
	TOTAL							3.3	2.3	0.57	2.1	0.13125

examined carefully for better understanding of the situation. These details are briefly discussed in the following sections.

The current practices for procurement of construction material were carefully evaluated during the study. Important details relevant to the study are summarized in Table 3.10. These details relate to haulage distance, quality of material, approval status with respect to Composite Schedule of Rates, and procurement costs at various Tehsils of Neelum district. Important findings of the study are briefly stated below:

(a) Sources within District Neelum

- 1 The only existing developed source of coarse aggregate in Neelum district is the quartzite bedrock. The source is located near Athmaqum. The source has limited reserves and according to the material characteristic and usage is defined marginal. The aggregate from this source is being used in the private construction and the source is not recommended in the Composite Schedule of Rates.
- 2 Marginal sources of fine aggregate are also available within the district at various localities (Keran, Changan, Kharigam, Sharda and Kel) and being exploited. The sand is procured from various reaches of Neelum River for local usage. The reserves of this sand are limited and seasonal.
- 3 Fine aggregate is extracted from (a) Neelum River at Chhalpani. These aggregates are used mostly for private construction. These sources are also not approved in the CSR.
- 4 No source is specified in CSR for masonry stone and road base/sub-base material. These materials are extracted from local sources near the project sites or project excavations, which are still not recommended and unapproved by the department.

(b) Sources within AJ&K other than District Neelum

- 5 Coarse aggregate comprising limestone and dolomite is transported to district Neelum from district Muzaffarabad.

(c) Sources outside AJ&K:

- 6 The coarse aggregate, both for cement and asphalt concrete located outside AJ&K include only the Margalla Limestone.
- 7 Coarse aggregate from this source mostly reach district Neelum through Muzaffarabad-Neelum road.
- 8 Margalla Limestone is the only source for coarse aggregate that is approved and recommended in the Composite Schedule of Rates of AJ&K.
- 9 Fine aggregate is mostly brought from Lawrencepur, which is suitable for use and is also included in the Composite Schedule of Rates.
- 10 No masonry stone and road base/subbase material are brought from outside AJ&K.

3.12 District Poonch

The material used within district Poonch are borrowed from various existing sources located in AJ&K and Pakistan. Some relevant details concerning these sources were examined carefully for better understanding of the situation. These details are briefly discussed in the following sections.

The current practices for procurement of construction material were carefully evaluated during the study. Important details relevant to the study are summarized in Table 3.11.

CONSTRUCTION MATERIAL SOURCES IN AND AROUND AZAD JAMMU & KASHMIR																		
TABLE 3.10																		
Current Practices for Procurement of Construction Materials in District Kotli																		
Sr. No.	Source Name	Quality Acceptance	Status with respect to CSR	Contribution of the Source	At Source Cost Including Loading (Rs/CFT)	Estimated Procurement Cost (Rs/ CFT)												
						Kotli			Nikial			Khoi Rata			Sensa			
						Haulage (Km)	Transportation Cost (Rs/CFT)	Procurement Cost (Rs/CFT)	Haulage (Km)	Transportation Cost (Rs/CFT)	Procurement Cost (Rs/CFT)	Haulage (Km)	Transportation Cost (Rs/CFT)	Procurement Cost (Rs/CFT)	Haulage (Km)	Transportation Cost (Rs/CFT)	Procurement Cost (Rs/CFT)	
Sources within Kotli																		
1	Kotli - Nikial Anticline	Yes	Not Approved	Major	20.0	25	10.0	30.0	5	5.0	25.0	60.0	20.0	40.0	50	20	40	
2	Khoi Rata Anticline • Kerjai Dolomite Source	Yes	Not Approved	Minor	-	45	-	-	35	-	-	16.0	-	-	65	-	-	
3	Murree Formation	No	Not Approved	Minor	-	20	-	-	50	-	-	55.0	-	-	50	-	-	
4	Poonch River Gravel-I	No	Not Approved	Moderate	19.0	26	10.0	29.0	45	-	-	60.0	-	-	55	-	-	
5	Poonch River Gravel-II	No	Not Approved	Moderate	21.0	3	5.0	26.0	30	-	-	40.0	-	-	15	10	31	
6	Poonch Terraces	No	Not Approved	Moderate	20.0	6	5.0	25.0	25	-	-	30.0	-	-	36	-	-	
7	Khorbun Nullah Gravel	No	Not Approved	Moderate	18.0	28	10.0	28.0	26	10.0	28.0	5.0	5.0	23.0	60	-	-	
Sources Outside AJ&K Hauled through GT Road																		
1	Margalla Limestone Rock Quarry (Hatta Taxila)	Yes	Approved	Major	12.0	175	30.0	42.0	212	35.0	47.0	205.0	35.0	42.0	145	25	37	
3	Chenab Sand	Yes	Approved	Major	12.0	170	25.0	37.0	205	35.0	47.0	200.0	35.0	47.0	200	35	47	
4	Lawrencepur Sand Deposits (Qibla Bandi)	Yes	Approved	Major	6.0	205	30.0	36.0	240	44.0	50.0	235.0	40.0	46.0	175	24	30	

CONSTRUCTION MATERIAL SOURCES IN AND AROUND AZAD JAMMU & KASHMIR														
TABLE 3.11														
Current Practices for Procurement of Construction Materials in District Mirpur														
Sr. No.	Source Name	Quality Acceptance	Status with respect to CSR-2004	Contribution of the Source	At Source Cost Including Loading (Rs/CFT)	Estimated Procurement Cost (Rs/ CFT)								
						Mirpur			Chakswari			Dudial		
						Haulage (Km)	Transportation Cost (Rs/CFT)	Procurement Cost (Rs/CFT)	Haulage (Km)	Transportation Cost (Rs/CFT)	Procurement Cost (Rs/CFT)	Haulage (Km)	Transportation Cost (Rs/CFT)	Procurement Cost (Rs/CFT)
Sources within Tehsils														
1	Khari Sharif Terrace/Nullah Gravel Mirpur	Marginal	Not Approved	Minor	12.0	12	12.0	24.0	52	-	-	82	-	-
2	Mangla Jatli Terrace Gravel Mirpur	Marginal	Not Approved	Moderate	12.0	20	15.0	27.0	60	-	-	90	-	-
3	Jeri Kas (Nullah) Gravel Mirpur	Marginal	Not Approved	Moderate	12.0	16	13.0	25.0	28	-	-	62	-	-
4	Saketar Nullah Gravel Mirpur	Marginal	Not Approved	Moderate	12.0	20	15.0	27.0	32	-	-	66	-	-
5	Kanali-Kas (Nullah) Gravel	Marginal	Not Approved	Moderate	12.0	30	-	-	10	10.0	22.0	40	20.0	32.0
6	Har Kas (Nullah) Gravel Islam Gargh	Marginal	Not Approved	Moderate	12.0	32	-	-	8	10.0	22.0	38	20.0	32.0
7	Ganoi Kas (Nullah)- Terrace Deposits Chaksawari	Marginal	Not Approved	Major	12.0	45	-	-	5	8.0	20.0	25	13.0	25.0
8	Kot Sarsawa Terrace Deposits Chaksawari (Palak)	Marginal	Not Approved	Moderate	12.0	35	-	-	5	8.0	20.0	35	15.0	27.0
9	Dudial Terrace/ River Gravel Deposits	Marginal	Not Approved	Moderate	12.0	70	-	-	30	15.0	27.0	2	5.0	17.0
10	Jutlan Nullah/ Terrace Sand Deposits D/S of Jutlan Head Works	Marginal	Not Approved	Moderate	10.0	25	15.0	25.0	40	20.0	30.0	70	20.0	30.0
Sources Outside AJ&K														
1	Margalla Limestone Rock Quarry (Hatta Taxila)	Yes	Approved	Major	12.0	150	20.0	32.0	190	25.0	37.0	220	30.0	42.0
2	Lawrencepur Sand	Yes	Approved	Major	12.0	180	25.0	37.0	220	28.0	40.0	250	35.0	47.0
3	Chenab Sand	Marginal	Approved	Major	6.0	110	20.0	26.0	150	25.0	31.0	180	30.0	36.0

These details relate to haulage distance, quality of material, approval status with respect to Composite Schedule of Rates, and procurement costs at various tehsils of district Poonch. Important findings of the study are briefly stated below:

(a) Sources within District Poonch

- 1 Coarse aggregate from bedrock and riverbed/nullahbed are procured from various localities within the following three sources. The sources are located (a) Sandstone outcrops of Murree Formation, (b) Rangar Nullah (c) Poonch Riverbed and Tributaries of Poonch River.
- 2 The aggregate from Ranger Nullah and Poonch Riverbed sources are being used in the private construction, however none of the sources are recommended in the Composite Schedule of Rates for public sector.
- 3 The limited marginal fine to medium sand is procured from Rangar Nullah and Poonch River at few reaches. The sand is being used in private construction.
- 4 No source of quality fine aggregate is available within the district.
- 5 No proper source is specified in CSR for masonry stone and road base/subbase material. These materials are extracted from local sources near the project sites or project excavations.

(b) Sources within AJ&K other than District Poonch.

- 1 Material is transported to district Poonch from adjacent areas of district Kotli.

(c) Sources outside AJ&K

- 1 The coarse aggregate both for cement and asphalt concrete located outside AJ&K in Pakistan include only the Margalla Limestone.
- 2 Coarse aggregate from this source mostly reach district Poonch through Azad Pattan Road.
- 3 Margalla Limestone is the only source for coarse aggregate that is approved and recommended in the Composite Schedule of Rates for AJ&K.
- 4 Fine aggregate is mostly brought from Lawrencepur, which is suitable for use and is also included in the Composite Schedule of Rates.
- 5 No masonry stone is brought from outside AJ&K, but road base/ subbase material is also brought from outside AJ&K.

3.13 District Sudhnuti

The material used within district Sudhnuti are borrowed from various existing sources located outside AJ&K in Pakistan. Some relevant details concerning these sources were examined carefully for better understanding of the situation. These details are briefly discussed in the following sections.

The current practices for procurement of construction material were carefully evaluated during the study. Important details relevant to the study are summarized in **Table 3.12**. These details relate to haulage distance, quality of material, approval status with respect to composite schedule of rates, and procurement costs at Palandri tehsil of district Sudhnuti. Important findings of the study are briefly stated below:

(a) Sources within District Sudhnuti

CONSTRUCTION MATERIAL SOURCES IN AND AROUND AZAD JAMMU & KASHMIR														
TABLE 3.12														
Current Practices for Procurement of Construction Materials in District Bhimber														
Sr. No.	Source Name	Quality Acceptance	Status with respect to CSR - 2004	Contribution of the Source	At Source Cost including Loading (Rs/CFT)	Estimated Procurement Cost (Rs/ CFT)								
						Bhimber			Samani			Bernala		
						Haulage (Km)	Transportation Cost (Rs/CFT)	Procurement Cost (Rs/CFT)	Haulage (Km)	Transportation Cost (Rs/CFT)	Procurement Cost (Rs/CFT)	Haulage (Km)	Transportation Cost (Rs/CFT)	Procurement Cost (Rs/CFT)
Sources within Tehsils														
1	Bhimber Nullah Sand	Marginal	Not Approved	Minor	10.0	1	5.0	15.0	40	-	-	34	-	-
2	Bhring Iftikharabad Nullah Sand	Marginal	Not Approved	Minor	10.0	15	8.0	18.0	55	-	-	20	-	-
3	Panjeri Nullah Bed Deposits	Marginal	Not Approved	Moderate	12.0	12	10.0	22.0	52	20.0	32.0	45	-	-
4	Dhandar Kot Nullah/Terrace Gravel	Marginal	Not Approved	Moderate	12.0	35.0	15	27.0	70	25.0	37.0	5	8.0	20.0
5	Khadala Nullah Sand	Marginal	Not Approved	Moderate	10.0	30	15.0	25.0	65	20.0	30.0	5	8.0	18.0
6	Chapiran Nullah/Terrace Gravel Chaprian (Bunder Kas)	Marginal	Not Approved	Moderate	12.0	18	15.0	27.0	58	20.0	32.0	52	-	-
7	Samani Nullah Sand	Marginal	Not Approved	Minor	10.0	6	5.0	15.0	35	15.0	25.0	45	-	-
8	Dharia 2 km from Bhimber Samani Road				-	2	-	-	38	-	-	42	-	-
Sources Outside AJ&K														
1	Margalla Limestone Rock Quarry (Hatta Taxila)	Yes	Approved	Major	12.0	195	25.0	37.0	235	30.0	42.0	230	25.0	37.0
2	Lawrencepur Sand	Yes	Approved	Major	12.0	225	30.0	42.0	255	35.0	47.0	260	35.0	47.0
3	Chenab Sand	Marginal	Approved	Major	6.0	100	20.0	26.0	140	25.0	31.0	135	25.0	31.0

- 1 Coarse aggregate from bedrock are procured from various localities within three sources of Murree Formation.
- 2 The stratigraphic setup of the area mostly comprising of Siwalik group including early and middle Siwalik rocks. Chinji, Nagri and Dhok Pathan Formations are exposed in the area. The rocks of these formations are of soft and friable nature and are not suitable as aggregate material. Neither used in the private construction nor recommended in the Composite Schedule of Rates.
- 3 No source of fine aggregate is available within the district.
- 4 No proper source is specified in CSR for masonry stone and road base/sub-base material. These materials are extracted from local sources as described near the project sites or project excavations.

(b) Sources within AJ&K other than District Sudhnuti

- 5 Small quantity of material is transported to district Sudhnuti from district Poonch for masonry stone and road base/subbase material.

(c) Sources outside AJ&K

- 6 The coarse aggregate both for cement and asphalt concrete located outside AJ&K in Pakistan include only the Margalla Limestone.
- 7 Coarse aggregate from this source mostly reach Sudhnuti through Azad Pattan road.
- 8 Margalla Limestone is the only source for coarse aggregate that is approved and recommended in the Composite Schedule of Rates of AJ&K.
- 9 Fine aggregate is mostly brought from Lawrencepur, which is suitable for use and is also included in the Composite Schedule of Rates.
- 10 Masonry stone and road base/subbase material is brought from outside.

3.14 Quarrying/ Borrowing Practices in Districts Neelum, Poonch and Sudhnuti

Current quarrying and borrowing practices at the existing material sources located within Neelum, Poonch and Sudhnuti districts and relevant sources of Pakistan are summarized in **Table 3.13, 3.14, 3.15, 3.16 & 3.17** respectively. Important aspects of the practices being followed within the districts as briefly stated below:

- 1 Major quarrying activity is going on Rangar Nullah and Poonch River gravel source, where crushers are installed. The aggregate is mostly used within Poonch district. The aggregate comprises mostly of sandstone.
- 2 The hard rock quarries are not established in district Poonch.
- 3 Only one hard rock quarry is established in district Neelum. There is no control on the quality of aggregate produced.
- 4 Only three sandstone rock (marginal sources) are located in Sudhnuti district.
- 5 No commercial scale borrowing of sand are in operation in these three districts, small scale borrowing of sand is in operation in district Neelum.
- 6 There is no approved material source for masonry stone and road base/sub base in these districts. These are mostly extracted from excavations along the proposed as well as existing road.

CONSTRUCTION MATERIAL SOURCES IN AND AROUND AZAD JAMMU & KASHMIR																											
TABLE 3.13																											
Current Quarrying and Borrowing Practices at the Existing Material Sources located within Three Southern Districts (Kotli, Mirpur & Bhimber)																											
Sr. No.	Source Name	Location	Estimated Quantity			Current Quarrying/ Borrowing Practices							Blasting		Crushing		Screening			Loading			Ownership/ Leasing				
			Huge	Limited	Seasonal	Bank & Shelf Method	Full Face Method	Ripping	Hand Picking	Mechanical/ Shovel	Bulk Excavation	Digging	Digging and Screening	Drill & Blast	Crow Bar	Jaw Crushers	Beater Crushers	Crushing Units (Approx. No.)	Trommels	Vibrating Screens	Stationary Screens	Manual	Mechanical	Conveyor Belts	Public/ Leased	Public/ Unleased	Private
ROCK QUARRIES																											
1	Kotli-Nikial Anticline	Kotli	✓				✓							✓	✓		✓	4	✓			✓	✓		✓		✓
2	Khoi Rata Anticline	Kotli	✓											✓	✓						✓				✓		✓
3	Murree Formation	Kotli	✓											✓	✓						✓				✓		✓
4	Dharia Bhimber Samani Road	Bhimber		✓																					✓		✓
RIVER AND STREAM BED MATERIAL																											
1	Poonch River Gravel -I	Kotli	✓					✓	✓								✓	6	✓	✓		✓	✓		✓		✓
2	Poonch River Gravel -II	Kotli	✓					✓	✓								✓	8	✓	✓		✓	✓		✓		✓
3	Poonch Terraces	Kotli	✓					✓	✓								✓	6	✓			✓	✓		✓		✓
4	Khorbun Nullah Gravel	Kotli	✓					✓	✓								✓	4	✓			✓	✓		✓		✓
5	Khari Sharif	Mirpur		✓				✓	✓								✓	1	✓			✓	✓		✓		✓
6	Mangla Jatli	Mirpur	✓					✓	✓								✓	2	✓	✓		✓	✓		✓		✓
7	Jeri Kas	Mirpur		✓				✓	✓								✓	3	✓			✓	✓		✓		✓
8	Saketar	Mirpur	✓					✓	✓								✓	1	✓			✓			✓		✓
9	Kanali Kas	Mirpur		✓				✓	✓								✓	1	✓			✓			✓		✓
10	Har Kas	Mirpur		✓				✓	✓								✓	1	✓			✓			✓		✓
11	Ganoi Kas	Mirpur	✓					✓	✓								✓	5	✓	✓		✓	✓		✓		✓
12	Kot SarsawaTerrace	Mirpur		✓				✓	✓								✓	1	✓	✓		✓	✓		✓		✓
13	Dudial Terrace	Mirpur		✓				✓	✓								✓	4	✓			✓	✓		✓		✓
14	Panjari Nullah	Bhimber	✓					✓	✓								✓	1	✓			✓			✓		✓
15	Dhandar Nullah/ Terrace	Bhimber	✓					✓	✓								✓	10	✓	✓		✓	✓		✓		✓
16	Chaprian	Bhimber	✓					✓	✓								✓	1	✓			✓			✓		✓
NATURAL SAND																											
1	Jatilan Nullah	Mirpur		✓	✓								✓								✓				✓		✓
2	Bhimber Nullah	Bhimber		✓	✓								✓								✓				✓		✓
3	Bhring Nullah	Bhimber		✓	✓								✓								✓				✓		✓
4	Khadala Nullah	Bhimber	✓										✓								✓				✓		✓
5	Samani Nullah	Bhimber			✓								✓								✓				✓		✓

CONSTRUCTION MATERIAL SOURCES IN AND AROUND AZAD JAMMU & KASHMIR												
TABLE 3.14												
Current Practices for Procurement of Construction Materials in District Neelum												
Sr. No.	Source Code	Source Name	Quality Acceptance	Status with respect to CSR -2004	Contribution of the Source	At Source Cost including Loading (Rs/CFT)	Estimated Procurement Cost (Rs/ CFT)					
							Athmaqum			Sharda		
							Haulage (Km)	Transportation Cost (Rs/CFT)	Procurement Cost (Rs/CFT)	Haulage (Km)	Transportation Cost (Rs/CFT)	Procurement Cost (Rs/CFT)
Sources within Neelum District												
1	NM-01	Nauseri Volcanics (Basalt)	Marginal	Not Approved	Undeveloped	-	38	-	-	117	-	-
2	NM-02	Nauseri Dolerites	Yes	Not Approved	Undeveloped	-	38	-	-	117	-	-
3	NM-03	Islampur-Jura Granite Sandok	No	Not Approved	Undeveloped	-	2	-	-	94	-	-
4	NM-04	Neelum Granite Keran	No	Not Approved	Undeveloped	-	3	-	-	89	-	-
5	NM-05	Dudhnia Meta Carbonate	Marginal	Not Approved	Undeveloped	-	40	-	-	39	-	-
6	NM-06	Malik Seri Dolerite Kharigam	Yes	Not Approved	Undeveloped	-	36	-	-	3	-	-
7	NM-08	Sharda-Shaikh Bela Schist	No	Not Approved	Undeveloped	-	42	-	-	2	-	-
8	NM-09	Kel-Shaikh Bela Schist	No	Not Approved	Undeveloped	-	76	-	-	16	-	-
9	NM-10	Dhokran Schist Kel	No	Not Approved	Undeveloped	-	91	-	-	31	-	-
10	NM-11	Changan Meta Dolerite	Yes	Not Approved	Undeveloped	-	36	-	-	42	-	-
11	NM-12MZ	Balgran Volcanics (Meta Basalt)	Marginal	Not Approved	Undeveloped	-	50	-	-	129	-	-
12	NM-13MZ	Dhara Balgran Meta Carbonate	Marginal	Not Approved	Undeveloped	-	48	-	-	127	-	-
13	NM-07	Neelum River Sand (Kel - Sharda - Kharigam - Changan-Keran-Salkhala)	Marginal	Not Approved	Minor	15.0	36	20.0	35.0	3	10.0	25.0
Sources Outside AJ&K Hauled through GT Road												
1	P-7	Margalla Limestone Rock Quarry (Hatta Taxila)	Yes	Approved	Major	15.0	220	50.0	65.0	300	70.0	85.0
2	P-8	Lawrencepur Sand Deposits (Qibla Bandi)	Yes	Approved	Major	8.0	255	52.0	60.0	334	72.0	80.0

CONSTRUCTION MATERIAL SOURCES IN AND AROUND AZAD JAMMU & KASHMIR																						
TABLE 3.15																						
Current Practices for Procurement of Construction Materials in District Poonch																						
Sr. No.	Source Code	Sample No.	Source Name	Quality Acceptance	Status with respect to CSR -2004	Contribution of the Source	At Source Cost Including Loading (Rs/CFT)	Estimated Procurement Cost (Rs/CFT)														
								Rawalakot			Hajira			Thorar			Abbaspur					
								Haulage (Km)	Transportation Cost (Rs/CFT)	Procurement Cost (Rs/CFT)	Haulage (Km)	Transportation Cost (Rs)	Procurement Cost (Rs/CFT)	Haulage (Km)	Transportation Cost (Rs/CFT)	Procurement Cost (Rs/CFT)	Haulage (Km)	Transportation Cost (Rs/CFT)	Procurement Cost (Rs/CFT)			
Sources within Tehsils																						
1	PN-01	JTD-01	Jabran-Dalkot	Marginal	Not Approved	NA	NA															
2		SK-01	Sambalari Khud Bazar				NA															
3		TJ-01	Titrot Jhandala				NA															
4	PN-02	MC-01	Mang Cross & Ghohi Nullah Bed (20 km from RWK)	Marginal	Not Approved	NA	NA															
5		MD-1	Maidan (7 km from RWK)				NA															
6		MD-2	Maidan (6 km from RWK)				NA															
7	PN-03	KD-01	Khai Gala Dothan Village	Marginal	Not Approved	NA	NA															
8	PN-04	RN-01	Rangar Nullah (Abbaspur)	Marginal	Not Approved	Major	15										1	10.0	25.0			
9		RN-02	Rangar Nullah (Hajira)				15	35	15.0	30.0	2	10.0	25.0	55.0	25.0	40.0						
10		RN-03	Rangar Nullah (Hajira)				15	36	15.0	30.0	3	10.0	25.0	56.0	25.0	40.0						
11	PN-05	MV-01	Mangora Village	Marginal	Not Approved	NA	NA															
12		KK-01	Kot Koian				NA															
13		NR-01	Nakkar (About 7 km from Hajira & 23 km from Abbaspur)				NA															
14	PN-06	PN-6	Jaboti-Ali Sojal Section(Outcrop) Shaheed Gala	Marginal	Not Approved	NA	NA															
15	PN-07	PN-7	Jaboti-Tolipeer Section(Outcrop)	Marginal	Not Approved	NA	NA															
Sources Outside AJ&K																						
1	P-7		Margalla Limestone Rock Quarry (Hatta Taxila)	Yes	Approved	Major	12.0	150	25.0	37.0	185	33.0	45.0	170	30.0	42.0	215	30.0	42.0			
2	P-8		Lawrencepur Sand	Yes	Approved	Major	8.0	180	25.0	33.0	215	28.0	36.0	200	30.0	38.0	245	35.0	43.0			

CONSTRUCTION MATERIAL SOURCES IN AND AROUND AZAD JAMMU & KASHMIR

TABLE 3.16

Current Practices for Procurement of Construction Materials in District Sudhnuti

Sr. No.	Source Code	Sample No.	Source Name	Quality Acceptance	Status with respect to CSR-2004	Contribution of the Source	At Source Cost Including Loading (Rs/CFT)	Estimated Procurement Cost (Rs/CFT)		
								Sudhnuti		
								Haulage (Km)	Transportation Cost (Rs/CFT)	Procurement Cost (Rs/CFT)
1	SD-9	SD-9	Pappe Nar Sandstone(Outcrop)	Marginal	Not Approved	NA	NA	NA	NA	NA
2	SD-10	SD-10	Pappe Nar Sandstone(Outcrop)	Marginal						
3	SD-11	SD-11	Nar Brahmanan Sandstone(Outcrop)	Marginal						
Sources Outside AJ&K Hauled through Azad Pattan Road										
1	P-7		Margalla Limestone Rock Quarry (Hatta Taxila)	Yes	Approved	Major	12.0	140	27.0	39.0
2	P-8		Lawrencepur Sand	Yes	Approved	Major	8.0	170	30.0	38.0

CONSTRUCTION MATERIAL SOURCES IN AND AROUND AZAD JAMMU & KASHMIR																											
TABLE 3.17																											
Current Quarrying and Borrowing Practices at the Existing Material Sources located within Three Districts (Neelum, Poonch & Sudhnuti)																											
Sr. No.	Source Code	Source Name	Location	Estimated Quantity			Current Quarrying/ Borrowing Practices							Blasting		Crushing			Screening			Loading			Ownership/ Leasing		
							Rock Quarry		Stream Bed Gravel Boulders		Stream Bed Sand																
				Huge	Limited	Seasonal	Bench & Shelf Method	Full Face Method	Ripping	Hand Picking	Mechanical/Shovel	Bulk Excavation	Digging	Digging and Screening	Drill & Blast	Crow Bar	Jaw Crushers	Beater Crushers	Crushing Units (Approx. No.)	Trommels	Vibrating Screens	Stationary Screens	Manual	Mechanical	Conveyor Belts	Public/ Leased	Public/Unleased
ROCK QUARRIES																											
1	NM-01	Nauseri Volcanics (Basalt) Nauseri	Neelum	✓																							
2	NM-02	Nauseri Dolerites Nauseri	Neelum	✓																							
3	NM-03	Islampur-Jura Granite Sandok	Neelum	✓																							
4	NM-04	Neelum Granite Keran	Neelum	✓																							
5	NM-05	Dudhnial Arenaceous Dolomite	Neelum	✓																							
6	NM-06	Malik Seri Dolerite Kharigam	Neelum	✓																							
7	NM-08	Sharda-Shaikh Bela Schist	Neelum	✓																							
8	NM-09	Kel-Shaikh Bela Schist	Neelum	✓																							
9	NM-10	Dhokran Schist Kel	Neelum	✓																							
10	NM-11	Changan Meta Dolerite	Neelum		✓																						
11	NM-12MZ	Balgran Volcanics (Meta Basalt)	Muzaffarabad/ Neelum	✓																							
12	NM-13MZ	Dhara Balgran Meta Carbonates	Muzaffarabad/ Neelum	✓																							
13	PN-1	Jabran-Dalkot	Poonch		✓																						
14		Sambalari Khud Bazar	Poonch		✓																						
15		Titrot Jhandala	Poonch		✓																						
16	PN-2	Mang Cross & Ghohi Nullah bed (20 km from RWK)	Poonch	✓																							
17		Maidan (7 km from Rawala Kot)	Poonch	✓																							
18		Maidan (6 km from Rawala Kot)	Poonch	✓																							
19	PN-3	Khari Gala Dothan Village	Poonch	✓																							
20	PN-5	Mangora Village	Poonch	✓																							
21		Kot Koian	Poonch	✓																							
22		Nakkar (About 7 km from Hajira & 23 km from Abbaspur)	Poonch	✓																							
23	PN-6	Jaboti-Ali Sojal section(Outcrop) Shaheed Gala	Poonch		✓																						
24	PN-7	Jaboti-Tolipeer section(Outcrop)	Poonch		✓																						
25	SD-9	Pappe Nar Sandstone(Outcrop)	Sudhnuti		✓																						
26	SD-10	Pappe Nar Sandstone(Outcrop)	Sudhnuti		✓																						
27	SD-11	Nar Brahmanan Sandstone(Outcrop)	Sudhnuti		✓																						
NATURAL SAND AND CRUSHED FROM NULLAH BED MATERIAL																											
1	NM-07	Neelum River Sand (Kel - Sharda - Kharigam - Changan-Keran-Salkhala)	Neelum		✓	✓						✓	✓								✓	✓			✓	✓	
2	PN-4	Rangar Nullah (Abbaspur)	Poonch	✓							✓	✓									✓	✓			✓	✓	
3		Rangar Nullah (Hajira)	Poonch	✓							✓	✓									✓	✓			✓	✓	
4		Rangar Nullah (Hajira)	Poonch	✓							✓	✓									✓	✓			✓	✓	

CHAPTER 4

METHODOLOGY AND CRITERIA

4.1 General

NESPAK adopted an interactive approach based on state-of-the-art practice. The study is being carried out with the help of GIS techniques, high resolution satellite images, geological maps, extensive field studies and specialized petrographic analysis and physical/chemical testing. The study was initiated immediately upon mobilization. During the study all major field activities were planned and executed in close coordination with the Client representatives. The field studies were followed by comprehensive qualitative screening procedures, which principally included petrographic analysis and physical/chemical testing.

The petrographic analyses were carried out using NESPAK in-house facility, while the physical tests were conducted at Central Material Testing Laboratory (WAPDA) and Road Research Institute (RRI) for reliable and authentic results. The results were reviewed and evaluated by experts having relevant experience for assessment of suitability of the investigated sources as construction material.

The Client was updated on the important findings of the study at various stages of the Study. This chapter provides details of technical approach and methodology adopted by NESPAK during the study conducted in the entire AJ&K and adjoining areas of Pakistan. This methodology and approach are similar to that adopted for the Pilot Study and Main Study in Southern districts. It also provides criteria adopted by NESPAK for evaluation of the field conditions and petrographic and physical test data.

4.2 Consultant's Approach

The Consultants developed a careful approach for carrying out a meaningful study. The approach was based on the base level information gathered, Terms of Reference and current state-of-art techniques being adopted for such studies. Some of the salient aspects of the approach are stated below:

- All-important study aspects were identified and discussed with the Client representatives before initiating the study.
- An interactive approach was adopted throughout the study; ensuring consultation with the Client at all important stages of investigation. All-important activities and interactions with the relevant field officials were conducted in coordination with the Client representative.
- The construction material being searched so far, are essentially include (a) fine and coarse aggregate for concrete, (b) aggregate for asphalt course, (c) base and subbase material, (d) stone for masonry works. Composite Schedule of Rates should be consulted for identifying various items produced from these materials.
- The study was extended outside AJ&K to cover the existing as well as potential sources of Pakistan that could be gainfully exploited for the State.
- A comprehensive understanding of the current practices for procurement of construction material was developed before initiating the field studies to address immediate issues and constraints.

- All local existing and potential material sources were identified and evaluated during the study, for their suitability for use in construction of private and public buildings, bridges and roads. Marginal usages of these sources are established, if so required.
- The study was conducted using aerial photographs and high-resolution satellite images, and adopting GIS (Geographic Information System) technology.
- The approach and methodology for the Study will match up to the geographic and geologic conditions of the other districts of the State as well.
- The study results are presented in manner useful for all stakeholders.

4.3 Methodology for the Main Study

NESPAK developed a comprehensive methodology for the study in accordance with the approach stated above and in consultation with the Client representatives. A sequential flow of major activities for overall study is shown in **Fig. 4.1**. The detailed activity sequence is shown in **Fig. 4.2** and a brief description of each activity is given below:

4.3.1 Interaction with the Client

NESPAK adopted an interactive approach for the study, ensuring (a) consultation with the Client nominated representatives while making all study parameters, (b) physical presence of the study coordinator while executing major field activities, and (c) well-timed sharing of the study findings with the senior governmental officials. These officials included Additional Chief Secretary, secretaries of relevant ministries, and senior officials from relevant departments.

Consultation with the Client's nominated representatives was the most important part of this interactive approach. The representatives included chief engineers, superintending engineers, executive engineers and research officers etc. The consultation covered various aspects including (a) types of building construction and roads, (b) identification of major settlements requiring construction material, (c) physical limitations for the identified material sources, (d) reference specification for evaluation of identified sources, (e) marginal usages of the local material, (f) relevant environmental concerns, (g) quarrying techniques, and (h) format of reports and maps.

4.3.2 Collection of Base Level Information

A comprehensive effort has been undertaken to collect base level relevant information for the study area. This information includes (a) technical reports and maps, (b) current material procurement practices in AJ&K, (c) existing local sources and their quarrying procedures, and (d) market rates at source as well as at district headquarters. This information was synthesized to identify the real issues being faced by the private as well as public sector consumers. Some of the important technical information collected in this regard is listed below:

- Topographic survey maps at scales 1:50,000 and 1:10,000,
- Satellite images of 2.5 m resolution of entire study area and 0.6 m resolution of selected areas,
- Geological maps produced by Geological Survey of Pakistan and AKMIDC.
- Space Radar Terrain Model data of 90 m resolution

Most of the above stated information was gathered with the help of P&D Department, Land Use Planning Section, and Central Design Office (CDO).

The information concerning current material procurement practices, existing quarrying procedures and market rates was gathered through extensive field surveys and interaction with the relevant government officials.

4.3.3 Preparation of Simplified Geological Maps

The geological information available on the maps and reports was synthesized to produce simplified geological maps. These maps showed spatial occurrence of various natural material types with respect to their potential of serving as construction material sources.

The natural material types identified on the maps included (a) material having potential for use as coarse aggregate, (b) material having potential for use as masonry stone, (c) material having potential for use as fine aggregate, and (d) material having almost no potential for use as construction material. These maps were supplemented with the information about existing material sources currently in use.

4.3.4 Identification of Construction Material Sources

The simplified geological maps and base level information collected during the study provided a reliable base to identify potential source locations for construction material. All necessary care; concerning accessibility and other physical constraints, was exercised during this identification process.

A preliminary reconnaissance of all the identified sources was carried out to verify the desk assessments and to qualify the sources for taking into the next evaluation stage. In this process additional potential source locations were also identified with relatively appropriate physical conditions.

4.3.5 Comprehensive Inventory of Material Sources for Evaluation

A comprehensive inventory of material sources was prepared for qualitative and quantitative evaluation. The inventory included all existing sources as well as potential sources identified under the current study. The inventory also showed intended appropriate uses of the source material and guidelines for field studies.

4.3.6 Rapid Environmental Appraisal

Rapid Environmental Appraisal of all identified material sources was conducted in the field. The appraisal covers (a) baseline physical, ecological and social conditions, (b) positive and adverse impacts of quarry development, (c) magnitude of the mitigation measures envisaged, and (d) recommendation for quarry development.

Brief appraisal reports have been prepared for each material source, finding of these reports are made part of this report.

4.3.7 Geological and Geotechnical Assessment

A Geological and geotechnical assessment of all identified material was conducted in the field. The assessment relates to (a) geographic position, physiography and accessibility (b) infrastructure available in the vicinity, (c) geological conditions and (d) geotechnical concerns. These assessments are recorded in the "Source Digest" prepared for each material source.

4.3.8 Field Sampling

Field samples of all identified material sources included are conducted as per the material type and intended uses. Types of samples collected during this process included as below:

4.3.8.1 Hand Samples

Representative hand samples were collected from all relevant source areas, while ensuring the following field observations:

- Observe all relevant physical features within source mass, like bedding, jointing, fracturing, weathering, and secondary veins, etc.
- Observe grain/clast size, and nature of the bio-clasts.
- Ensure representation of overall variations in the source mass.

These samples were shifted to the NESPAK House Lahore for megascopic examination, laboratory testing and petrographic analysis.

4.3.8.2 Bulk Samples

Bulk samples were collected in adequate number and weight from all existing and potential sources. These samples were transported to the Central Material Testing Laboratory (CMTL) WAPDA and Road Research Institute (RRI), Public Works Department, Government of Punjab at Lahore, to determine relevant physical and engineering characteristics.

4.3.9 Qualitative Evaluation

Qualitative evaluation of all the material sources was carried out in accordance with the Terms of Reference and specific potentials of each source. A three (3) tier evaluation program was adopted for this purpose, which included (a) assessment of mineralogical characteristics of the rock, (b) assessment of physical and engineering characteristics, and (c) evaluation of assessment results to establish suitability of sources as construction material. Methodology adopted for each of the above tiers is briefly discussed below and flow chart showing sequence of sampling and testing procedure is shown in **Fig. 4.3**.

Tier - 1 Assessing Mineralogical Characteristics

Mineralogical characteristics of the source material were determined through petrographic analysis, with an objective to find out presence of various deleterious materials. However, the petrographic analysis was considered relevant for the sources being examined for coarse aggregate for concrete and asphalt works.

The analysis was conducted using latest digital microscope supplemented with software. Photomicrographs of the thin sections were also captured through high-tech digital camera for record purposes.

An appropriate number of samples from each source; requiring this evaluation, were subjected to petrographic analysis following the standard practice suggested under ASTM C-295 to achieve the following objectives:

- Assess mineral composition of the source rocks and determine rock type
- Identify presence of deleterious minerals with respect to alkali-silica and alkali-carbonate reactions and establish their percentages.

- Identify minerals having hydrophilic affinity.
- Identify presence of micro-fractures within the source rock and their healing status.
- Provide a base for making a rational physical testing program in case the deleterious minerals are identified.

Thin sections were prepared for petrographic analyses. The criteria followed for preparation of thin section included as follows:

- Megascopic description of the sample to be recorded before preparing the thin section and accordingly representative part of the sample identified.
- Thin sections to be prepared across the bedding/foliation planes.
- Thickness of the slide not to be more than 30 microns.
- Thin sections to be of standard size with maximum possible size of the slide.
- All thin sections of carbonate and carbonate bearing rocks to be stained with Alizarin Red-S (half of the slide).
- All thin sections to be covered with "Glass Cover Slip" for longer preservation.

After conducting detailed analysis of each thin section, a summary of the texture and mineralogy of all thin sections of a source was prepared. This process included following steps:

- Preparing summary of texture and mineralogy of all samples analyzed from one source.
- Identifying samples giving anomalous results that are not consistent with the average results of the same source.
- Undertaking corrective actions with respect to samples giving anomalous results, such as adjusting the source area limits, suggesting quality control measures, etc.
- Calculating average results after discarding anomalous results.
- Preparing summarized findings of the petrographic analyses conducted on each source rock.

The summarized petrographic results of each source are made part of the "Source Digest". Moreover, the thin sections have also been preserved for future reference and reviews.

Tier - 2: Assessing Physical Engineering Characteristics

The bulk samples collected from various sources were subjected to appropriate tests at the Central Material Testing Laboratory (CMTL) WAPDA, Lahore and Road Research Institute (RRI), C&W Department, Government of Punjab, with an objective to find out their physical and engineering characteristics relevant to their intended uses. The testing program was formulated considering the material type and potentials as construction material.

The testing program included Gradation Test, Specific Gravity Test, Water Absorption Test, Los Angeles Abrasion Test, Impact and Crushing Value, 10% Fine Value, Sodium Sulfate Soundness Test, Sand Equivalent, Passing # 200 Sieve Test, Shape Test, Mortar Bar Expansion Test, and Bitumen Adhesion Test. The tests were conducted in

accordance with the relevant ASTM/ AASHTO/ BS Standards under the top supervision of NESPAK.

The Bitumen Adhesion tests were conducted on aggregate samples at Road Research Institute (RRI), C&W Department, Government of Punjab,

Summaries of the laboratory test results are presented in this report.

The sources declared ASR susceptible in petrographic analysis were subjected to specialized test "Accelerated Mortar Bar Test" as per ASTM C-1260. This test helped in re-confirming the ASR susceptibility in the source rocks.

Tier - 3: Establishing Suitability of the Sources

The assessed mineralogical, physical and engineering properties were used to establish suitability of the sources as construction material. This process was completed in three stages, as described briefly below:

Stage – 1 (Tier – 3): Evaluation of Mineralogical Characteristics

Mineralogical characteristics were used to determine suitability of the material as coarse aggregate for concrete with respect to Alkali-Silica Reaction (ASR) and Alkali-Carbonate Reaction (ACR).

The criteria considered for negating ASR susceptibility included as below:

"The rock mass contains (a) chert or chalcedony minerals less than 3 percent, (b) optically strained, micro-fractured or microcrystalline quartz less than 5 percent, (c) natural volcanic glass less than 3 percent, (d) greywacke, slate less than 15 percent, (e) opal less than 1 percent, and or tridymite or cristobalite less than 1 percent".

The criteria considered for declaring ACR susceptibility included as below:

"The rock mass (a) is very fine-grained dolomite (small crystals), (b) contains considerable amount of fine calcite, (c) contains abundant interstitial clay, (d) contains dolomite and calcite crystals evenly distributed in clay matrix, and or (e) has no potential of dedolomitization".

Stage – 2 (Tier – 3): Evaluation of Physical Engineering Characteristics

The physical and engineering characteristics determined through laboratory testing were compared with the acceptable limits suggested by the Specifications.

The relevance of the specifications and local practice being exercised are important tasks, which is required to be established for the evaluation purpose. Any set of specifications generally reflects the availability and quality of material, climate, traffic load and economics of the particular region where these specifications are developed. The three important sources i.e., ASTM, BS and AASHTO are widely referred specifications and used extensively for aggregate evaluation.

Since the wide variation in availability of suitable types of aggregate and economic circumstances throughout the world makes impractical any attempt to establish a single uniform range of specifications particularly for road aggregate applicable to all continents and countries, therefore during the Pilot Study specifications have been sought which best suit the local conditions of the study area. The National Highway Authority's Specifications are also consulted, but these specifications are found a bit less stringent particularly the Los Angeles Abrasion Value for various layers of road. This aspect has

been looked into more detail while preparing the specifications for roads during the Part-II of the study.

Keeping in view of the above, following criteria was established to evaluate the material and recommendations for usage:

- ASTM C-33 shall be made standard reference specifications for evaluation of coarse and fine aggregate in concrete construction.
- The American highway standards (AASHTO) are much quality demanding; however, the British standards, tentative recommendations of British Geological Society for evaluating the road aggregate and Transport Research Laboratory (TRL-UK) Overseas Road Note No. 31 give more relevant specifications applicable to Kashmir region. The mechanical requirement of road aggregate i.e., Los Angeles Abrasion Value, Crushing Value, Impact Value and 10% Fine Value (TFV) has been compared with these specifications for evaluation and recommendations.
- ASTM C-33 only provides specifications of fine aggregate for concrete and masonry mortar. For these two usages ASTM C-33 shall be made reference standard for evaluation. The other uses of the sand like plastering and rendering are evaluated as per the specifications of British Standards.
- Aggregate sources not fully meeting the ASTM or other standard requirements for use in high quality construction but in construction type where they can still be used without any particular cautions and certain safety margin will be declared as “Marginal Aggregate”.

The specific range of values for various tests as per the criteria mentioned above is summarized in **Table 4.1**.

Stage – 3 (Tier – 3): Marginal and Conditional Usage of ASR Susceptible material

Marginal and conditional usage of the ASR susceptible material for concrete production was also assessed in accordance with the provisions suggested by various international agencies including American Concrete Institute (ACI), ASTM, BS, AASHTO, Portland Cement Association (PCA) and California Department of Transport (CALTRANS). The criteria used for this purpose is stated below:

Marginal Use of ASR Susceptible Aggregate for Concrete Production

- Use aggregate in production of concrete having total alkali level “not more than 2.5 Kg/m³ from all sources- including aggregate as well as Ordinary Portland Cement”. This condition is for producing concrete up to 2000 psi strength for ordinary private and public sector buildings and load bearing concrete blocks. However, the criteria are relaxed for the structures of 3000 psi strength in which no direct risk of human lives are involved like isolated retaining walls, cause ways and culverts.

Conditional Use of ASR Susceptible Aggregate for Concrete Production

- Use aggregate with low alkali cements having alkalis less than 0.6% (preferably less than 0.4%).

Use aggregate with Ordinary Portland Cement and Ground Granulated Ballast Furnace Slag (GGBFS) of Grade 80 and 100 or with Fly Ash. The Specifications for slag and fly ash or pozzolan are mention in the **Tables 4.2 and 4.3**. Use aggregate with 85% by

CONSTRUCTION MATERIAL SOURCES IN AND AROUND AZAD JAMMU & KASHMIR

Table 4.1

Criteria Used for Evaluating the Material Sources

PHYSICAL ENGINEERING PARAMETERS	CONCRETE COARSE AGGREGATES	ROAD AGGREGATE										FINE AGGREGATES							
	ASTM C-33 SPECIFICATION LIMITS	*Tentative Limits										AASHTO	TRL	ASTM LIMITS	BS				
		Heavy Traffic Roads			Medium Traffic Roads			Light Traffic Roads†							Aggregate for Concrete and Mortar	Mortar and Plaster			
		All Unbound	Wearing Course	Bituminous Base/Sub-base	All Unbound	Wearing Course	Bituminous Base/Sub-base	All Unbound	Wearing Course	Bituminous Base/Sub-base	All type of roads	Bituminous Mixes	Unbound Pavement	Masonry Mortar		Floor Screed	External Rendering	Gypsum Plastering	Internal Plastering
Specific Gravity (not less than)	2.5																		
Water Absorption (not more than. %)	1																		
Sodium Sulfate Soundness (max. %)	12											12							
Los Angeles Abrasion Value (max. %)	50	25	25	35	30	30	35	35	30	35		30	35						
Materials Passing (No.200 sieve) (% by wt.)	3													3					
Shale (% by wt.)	1																		
Clay Lumps and Friable Particles (% by wt.)	2													3					
Other Deleterious Substances (% by wt.)	1																		
Impact Value (max.)		23	23	30	27	27	30	30	27	30		25							
Crushing Value (max.)		23	23	30	27	30	30	30	27	30		25							
10% Fine Value kN (min.) Dry		130	130	100	115	100	100	100	115	100	150		110						
10% Fine Value kN (min.) Soaked		80	65	50	65	65	50	50	65	50									
Flakiness (max.)												45	35						
Sand Grading														ASTM C-33	BS-1200	BS-112	BS-1199	BS-1198	BS-1199
Fineness Modulus														ASTM C-33					
Mortar Bar Expansion % (max.) at 14 days (ASTM 1260)	0.1													0.1					
Bitumen Adhesion (Not less than)												95	75						

Table 4.2
Standard Specifications for Ground Granulated Blast-Furnace Slag for Use in Concrete
and Mortars as Per ASTM 989

Chemical constituents (as oxides)	Range of composition percent by mass ASTM STP 169-B	
SiO ₂	30 - 40	
Al ₂ O ₃	8 -18	
CaO	40 - 50	
MgO	0 - 8	
S	0 – 2 *	
SO ₃	0 – 2 *	
Fe ₂ O ₃	0 - 1	
Mn ₂ O ₃	0 - 2	
Fineness: ASTM C989		
Amount retained when wet screened on a 45-µm (No.325) sieve, max%	20	
Specific surface by air permeability, Test Method C204 shall be determined and reported although no limits are required.	---	
Air Content of Slag Mortar ,max%	12	
Slag Activity Index, min,% ASTM C989	Average of Last Five Consecutive Samples	Any Individual Sample
7 Day Index		
Grade80	---	---
Grade100	75	70
Grade120	95	90
28 Day Index		
Grade 80	75	70
Grade100	95	90
Grade120	115	110

(*) As per ASTM C989

Sulfide sulphur (S), max,% 2.5

Sulfate reported as SO₃, max,% 4.0

Table 4.3
Standard Specifications for Coal Fly Ash and Raw or Calcined Natural Pozzolan
for Use in Concrete (ASTM C618)

Chemical Requirements	Mineral Admixture Class		
	N	F	C
Silicon dioxide (SiO ₂) plus aluminium oxide (Al ₂ O ₃) plus iron oxide (Fe ₂ O ₃), min, %	70.0	70.0	50.0
Sulphur trioxide (SO ₃), max, %	4.0	5.0	5.0
Moisture content, max,	3.0	3.0	3.0
Loss on ignition, max, %	10.0	6.0 ^A	6.0
Physical Requirements	Mineral Admixture Class		
	N	F	C
Fineness: Amount retained when wet-sieved on 45 µm (No. 325) sieve, max, % ^A	34	34	34
Strength activity index: ^A With Portland cement, at 7 days, min, percent of control	75 ^B	75 ^B	75 ^B
With Portland cement, at 28 days, min, percent of control	75 ^B	75 ^B	75 ^B
Water requirement, max, percent of control	115	105	105
Soundness: ^C Autoclave expansion or contraction, max, %	0.8	0.8	0.8
Uniformity requirements: The density and fineness of individual samples shall not vary from the average established by the ten preceding tests, or by all preceding tests if the number is less than ten, by more than: Density, max variation from average, %	5	5	5
% retained on 45-µm (No. 325), max variation, % points from average	5	5	5
Supplementary Requirement	Mineral Admixture Class		
	N	F	C
Multiple factor, calculated as the product of loss on ignition and fineness, amount retained when wet-sieved on 45-µm (No. 325) sieve, max, % ^A		255	
Increase of drying shrinkage of mortar bars at 28 days, max, difference, in %, over control ^B	0.03	0.03	0.03
Uniformity Requirements: In addition, when air-entraining concrete is specified, the quantity of air-entraining agent required to produce an air content of 18.0 vol. % of mortar shall not vary from the average established by the ten preceding tests or by all preceding tests if less than ten, by more than, %	20	20	20
Effectiveness in Controlling Alkali-Silica Reaction: ^C Expansion of test mixture as percentage of low-alkali cement control, at 14 days, max, %	100	100	100
Effectiveness in Contributing to Sulphate Resistance Procedure A: Expansion of test mixture: For moderate sulphate exposure after 6 months exposure, max, %	0.10	0.10	0.10
For high sulphate exposure after 6 months exposure, max, %	0.05	0.05	0.05
Procedure B: Expansion of test mixture as a percentage of sulphate resistance cement control after at least 6 months exposure, max, %	100	100	100

The superscripts in table should strictly be read in conjunction with the notes provided in ASTM C-618 for the above respective requirement.

Weight Ordinary Portland Cement and 15% by weight natural pozzolans having lime content up to 2% and total alkali content up to 3%.

4.3.10 Quantitative Assessment

Quantitative assessment of the material sources has been carried out using area-volume method. The statistics used for this purpose were based on topographic maps prepared from Space Rader Terrain Model (SRTM) Data of resolution 90 m along with following field techniques as the case may be:

- Field measurements through tape method and using SRTM based contour maps. Outline quarry plans; in case of major sources, were also considered for quantitative assessments.

4.3.11 Outline Quarry Development Plan of Major Sources

Outline quarry development plans were developed for major sources declared suitable for use as construction material under the present study. In order to prepare realistic and practical development plans, a detailed review of the current quarrying practices at Quarry, Kamsar Quarry, Lora Maqsood Quarry and other existing quarries was conducted. The methodology accordingly adopted for preparing outline quarry development plan is briefly discussed below:

- Conventional quarrying methods to be proposed for major rock quarries considered suitable for (a) aggregate and (b) base/ sub-base material. The proposed methods to be simpler and closer to those already being practiced at major quarry areas in Pakistan. Moreover, the proposed methods should not warrant high-tech quality control requirements.
- The quarrying methods for (a) local rock quarries having limited resources, and (b) stone for masonry and other works to be ensured simpler and suitable for small private endeavors.
- Considering the physiographic constraints, no specific borrowing techniques should be proposed for river sand and gravel sources.

Moreover, while preparing quarry development plan for a particular source, all important factors affecting its development were considered, including availability of manpower and infra-structural support, etc.

4.3.12 Comparative Financial Evaluation of Suitable Sources

The current at source production cost of various materials has been collected from the existing quarry and borrow areas. The same production cost has been assumed for the potential suitable sources as well for sake of initial comparison.

Comparative financial evaluation will be carried out to enable the authorities, private investors and users to set up serious cost estimates and forecasts.

A primary rate analysis of material produced from various identified sources will be made at the point of its production without adding the haulage cost to consumption centers. Since the degree of mechanization in the areas of AJ&K would not be as advanced as the other part of the country, a labor-intensive production for small aggregate producers will be used for rate analysis.

However, the criteria will be developed with the help of Client for calculating the unit cost of production for large units using dredging (grab and suction). Similarly, the rate of

production in case of hard exploitation would be different for small and large production units.

4.4 Construction Material Procurement Plan on District Level

Based on the reserves, qualitative evaluation, initial financial comparison, user defined specifications and market segment served by each source, a procurement plan has been recommended on district level. The plan suggests both short- and long-term proposals to be considered by the government for efficient and immediate use of the study findings.

CHAPTER 5

CONSTRUCTION MATERIAL SOURCES STUDY OF DISTRICT MUZAFFARABAD

5.1 General

Comprehensive construction material study of district Muzaffarabad, AJ&K was conducted in accordance with the Terms of Reference and the work methodology stated in the previous chapters. The study included assessment of area potential, identification of all existing and potential sources, qualitative/ quantitative evaluation, and accordingly determining their suitability for use as construction material for buildings, roads and bridges.

This chapter provides details of explorations, evaluations, and suitability assessments of all source's studies in district Muzaffarabad. The adequacy of construction material on district level is also discussed which would serve as a realistic base for preparing material procurement plan for the district.

5.2 Administrative Setup and Physiography

Districts Muzaffarabad extend over an area of 1642 , which hosts a population of about 650,371 persons (2017 Census). It shares inter-district boundaries with Neelum and Bagh districts in the north and south respectively. In the west, it is bounded by KPK and Punjab (Pakistan), while in the east is District Jhelum Valley.

The district comprises two tehsils, including Naseerabad, Muzaffarabad. Muzaffarabad city is the State capital as well as district headquarter. The other tehsil headquarters are Pattika town. The other main towns include Ghori, Chela Bandi, Ghari Dopatta, Chatter, Dana and Kohala.

The district forms part of Lesser Himalayan Zone, and its topography is mainly mountainous with valleys in between. The elevation ranges from 580 m to 4440 m. Pir Chinasi top is the major tourist spot in the district with elevation 3110 m. High angle slopes and steep escarpments are prominent features of the area.

The district Muzaffarabad; is drained by Neelum and Jhelum rivers and their tributaries. The two rivers join together within Muzaffarabad city.

The climate within the district varies greatly with altitude. The snowline in winters and summers times is at elevations 1200 and 3300 m respectively. The northern part is very cold in winter and moderate in summer, while the southern remains cold in winter and hot in summer. May, June and July are the hottest months, while December, January and February are the coldest months.

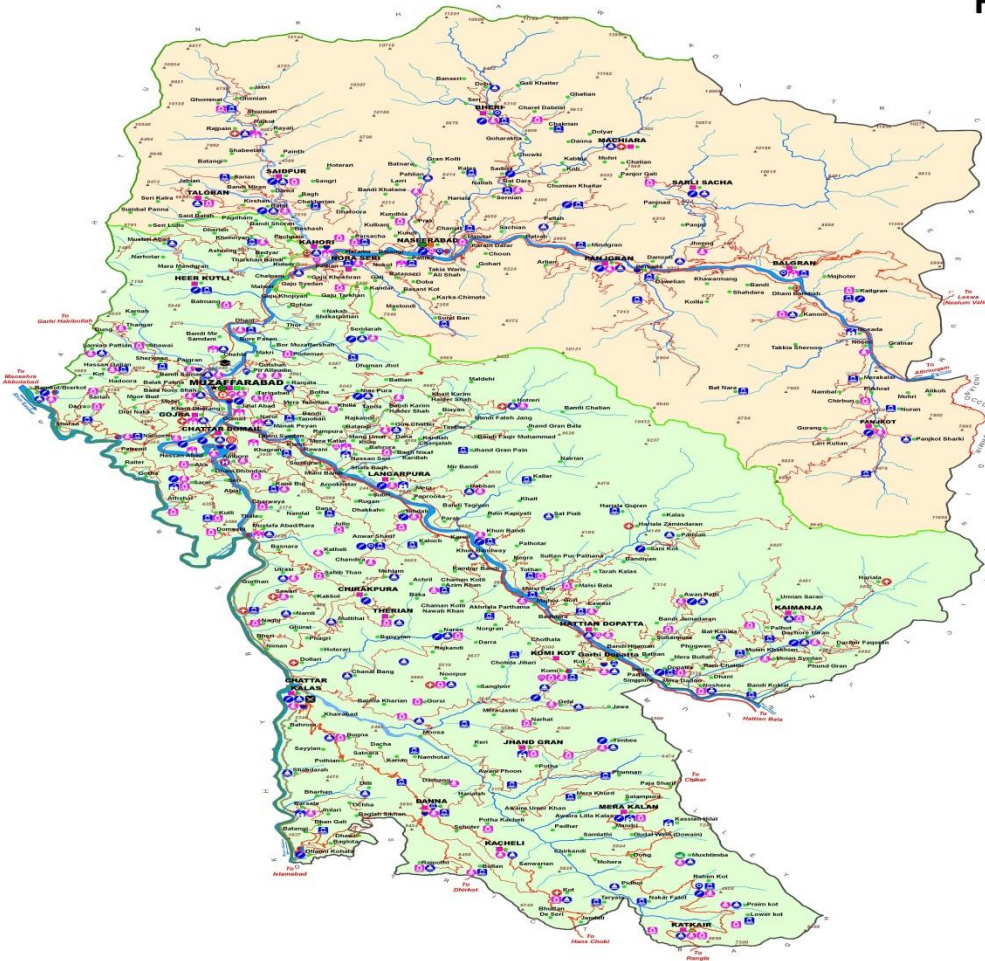
Muzaffarabad, the district headquarter, is 140 and 180 km from Rawalpindi via Murree and Abbottabad respectively.

Fig. 5.1 shows the administrative and physiographic details of districts Muzaffarabad.

5.3 Geology

Districts Muzaffarabad; situated in the axial zone of Hazara-Kashmir syntaxis, comprises part of the Lesser Himalayas. The syntaxis exhibits two major thrusts, including Panjal Thrust (PT) and Main Boundary Thrust (MBT) in the north and south respectively.

Figure: 5.1



**ADMINISTRATIVE MAP
DISTRICT MUZAFFARABAD**



SUMMARY STATISTICS

UNION COUNCILS	26
MUNICIPALITIES	3
PATWAR CIRCLES	56
REVENUE VILLAGES	415
POPULATION (2017) Census	650,371
AREA (Sq. km.)	1,642

Legend

- District Headquarter ★
- Tehsil Headquarter ●
- Union Council ●
- Municipal Corporation ●
- Municipal Committee ●
- Town Committee ●
- Revenue Village ●
- Elevation ASL (feet) ●
- Province Boundary —
- Line of Control —
- District Boundary —
- Tehsil Boundary —
- Expressway —
- National Highway —
- Main Road —
- Link Road —
- River —
- Nala —
- Police Station —
- Police Chowki —
- Health Facilities (Public Sector)**
- Abbas Institute of Medical Sciences (AIMS) —
- Combined Military Hospital (CMH) —
- Rural Health Center (RHC) —
- Basic Health Unit (BHU) ●
- Civil Dispensary (CD) ●
- Ushani Dispensary ●
- Education Facilities (Public Sector)**
- University of AJ&K (UJ&K) ●
- Govt. Boys Post Graduate College (GBPC) ●
- Govt. Girls Post Graduate College (GGPC) ●
- Govt. Boys Degree College (GBDC) ●
- Govt. Girls Degree College (GGDC) ●
- Govt. Boys Inter College (GBIC) ●
- Govt. Girls Inter College (GGIC) ●
- Govt. Model Science College ●
- Govt. Cadet College ●
- Govt. Boys Higher Secondary School (GBHSS) ●
- Govt. Girls Higher Secondary School (GGHSS) ●
- Govt. Boys High School (GBHS) ●
- Govt. Girls High School (GGHS) ●
- Govt. Boys Middle School (GBMS) ●
- Govt. Girls Middle School (GGMS) ●

OVERVIEW MAP



Map Prepared
Land Use Planning Section,
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Figure 5.1: Administrative Map of District Muzaffarabad

These thrusts have developed three distinct geologic domains within the study area with respect to their relative position within the syntaxis and geologic formations. These domains include (a) the area north of Panjal Thrust comprising older metamorphic rocks, (b) the area between Panjal and MBT comprising volcanic and meta-sediments, and (c) the area south of MBT mostly comprising molassic rocks. The molassic rocks comprise siltstone, sandstone and shale of early Miocene age.

In addition to the above, the areas forming major valley floors, which are mostly covered with thick terrace deposits comprising gravel and boulders embedded in clayey silt matrix. The hill slopes at places covered with colluviums of varying thicknesses. A simplified geological map is presented as **Fig. 5.2**.

5.4 Construction Material Prospecting

The geologic formations exposed within Muzaffarabad were carefully evaluated for their potential with respect to procurement of material for construction of buildings, bridges and roads. For this purpose, the geologic formations were categorized with respect to the broad engineering characteristics of various rock types. A map showing construction material prospects within the districts was prepared on the basis of this categorization, which is presented in **Fig. 5.3**. A summary of the inferences derived from this simplified map is presented below:

- The geologic formations exposed in 25% of the area have no prospect for concrete and asphalt aggregate as well as other major construction material required. These formations include Patala Shales, Hazara and Salkhala Formations.
- Murree and Kamliyal Formations (Rawalpindi Group) cover almost 78% of the total district area. These formations comprise sandstone and alternating beds of siltstone and shale. The siltstone and shale beds form more than two third of the geologic formation, however, they have no prospect usage as construction material. On the other hand, the sandstone beds are recognized as having marginal prospect depending upon the hardness and joint frequency of the individual beds.
- Geologic formations; having relatively higher potential for serving construction material; occupy only 3% area of the entire district. These formations include Margalla Limestone, Abbottabad Formation, Panjal Volcanic and associated sills/dykes and meta-sediments.
- Margalla Limestone is also exposed at Hill Seri Dera and Zahid Chowk localities.
- Nearly 3% of the area is covered with Quaternary deposits comprising mainly flood plain and terrace deposits, etc. Amongst these, only flood plain deposits have some prospects for construction material depending upon the rocks exposed in the stream catchments.

5.5 Exploration of Construction Material Sources

A comprehensive exploration program for identifying material suitable for use in construction of buildings, roads and bridges was executed. The program was based on the local physiographic conditions, assessment of geology and material prospecting, existing sources, relevant deficiencies and State needs. The program activities included systematic identification of sources, preliminary field demarcations and assessments, comprehensive sampling, qualitative assessments, rapid environmental examination and quantitative assessments.

Geological Map of District Muzaffarabad

Figure- 5.2

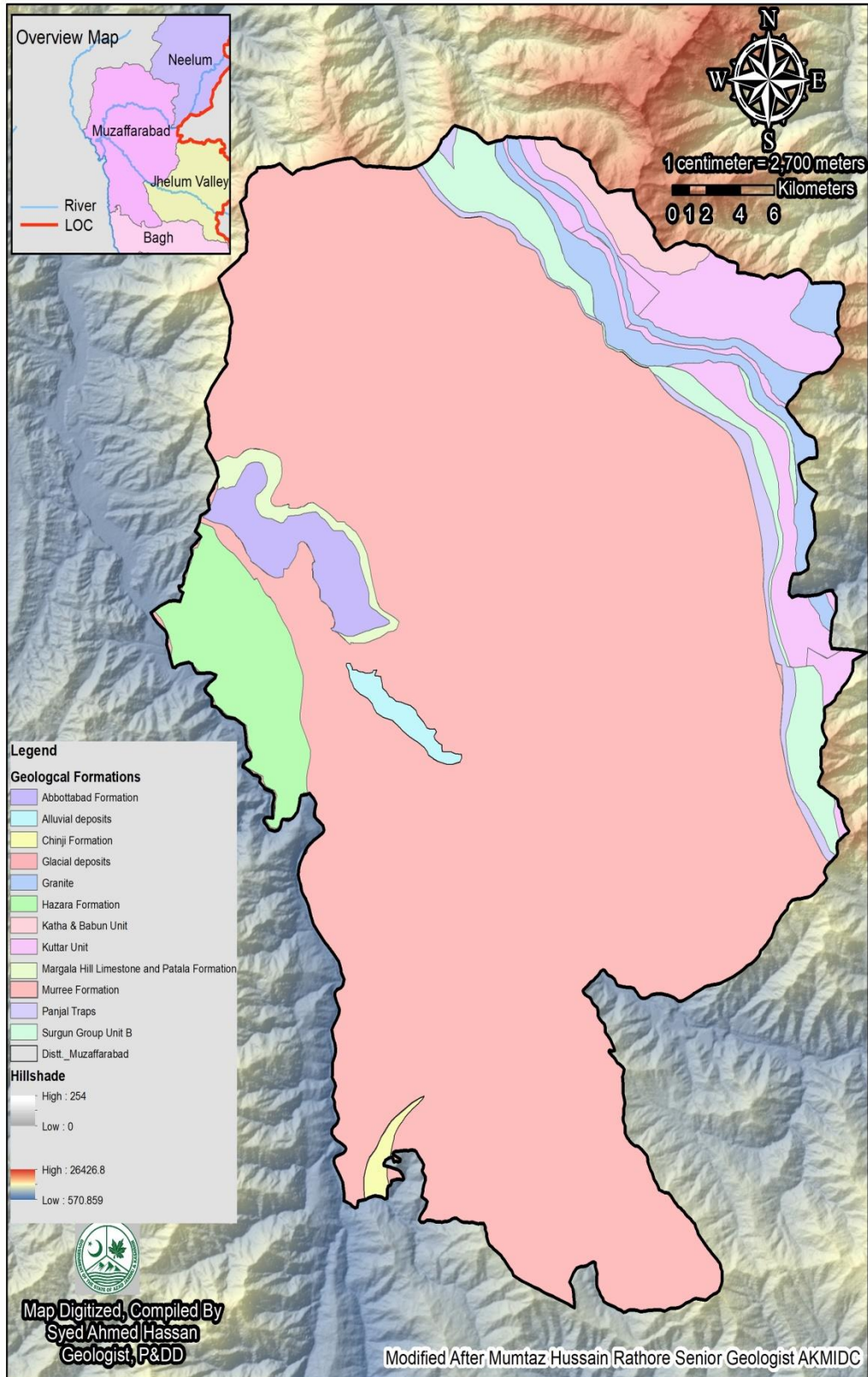


Figure 5.2: Geological Map of District Muzaffarabad

%age area Distribution w.r.t. Construction Material Prospect in District Muzaffarabad **Figure-5.3**

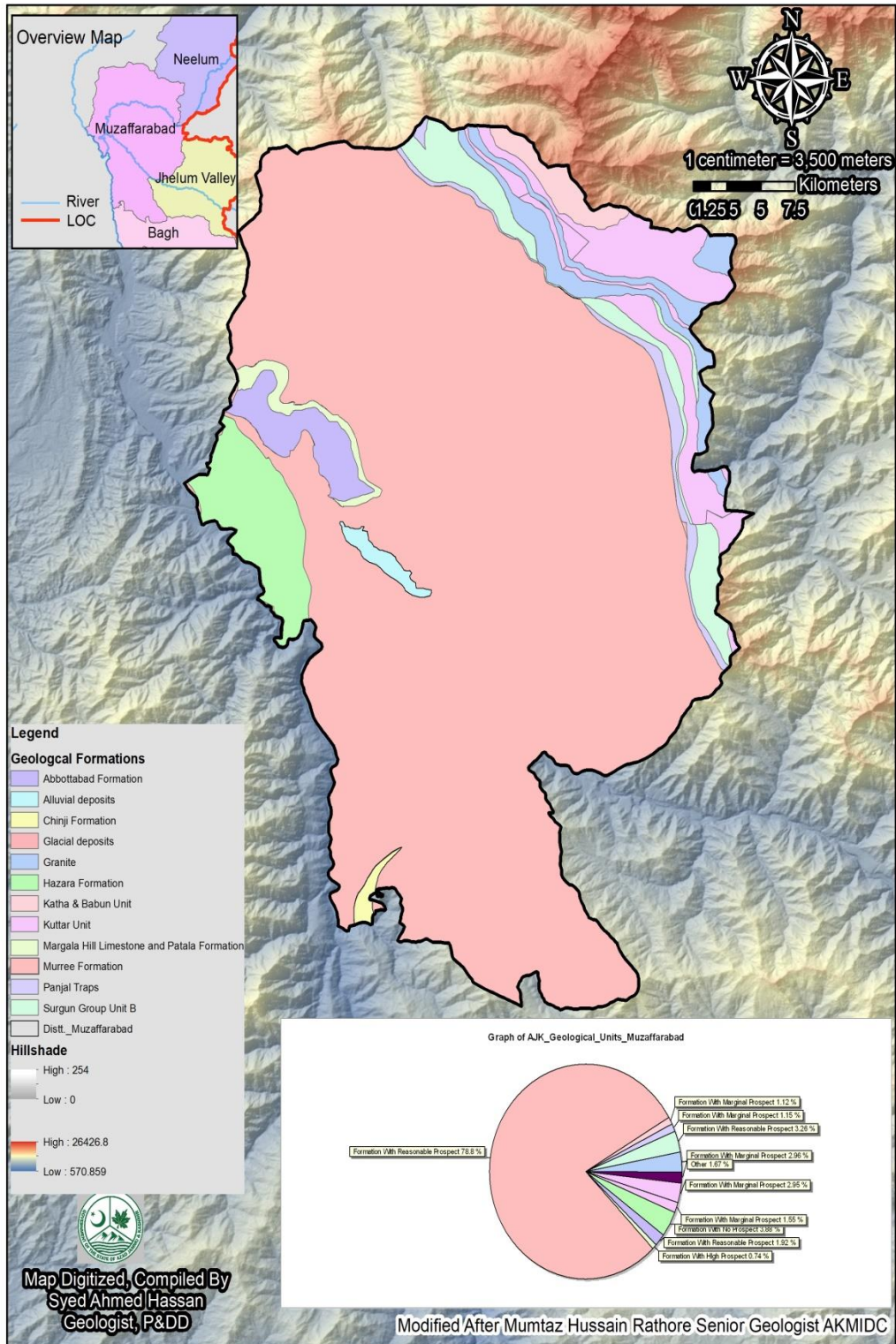


Figure 5.3: Construction Material Prospects of District Muzaffarabad

These activities were conducted in accordance with the criteria and methodology stated in the previous sections. A summary of the exploration program is given below:

- 1 Seventeen (17) sources were identified and studied within district. Amongst which 8 were evaluated as potential sources for coarse aggregate, base/sub-base material, and stones, while the rest were evaluated as potential sources for fine aggregate. Locations of all these sources are shown in **Fig. 5.4**.
- 2 Rapid environmental examination of all the sources was conducted in the very beginning of the exploration. Moreover, a comprehensive review of the existing quarrying techniques and material procurement procedures was carried out.
- 3 Hand samples were collected from these sources, out of which representative samples were analyzed through petrographic microscope after preparing thin sections. Set of petrographic analysis results for each source was evaluated with respect to perspective usages of the material.
- 4 Bulk samples were collected from these sources and were analyzed for physical properties at the Central material Testing Laboratory, WAPDA and Road Research Institute, C&W Department, Government of Punjab. The testing program was prepared considering the expected uses of the material and laboratory test results were accordingly evaluated.

5.6 Source Digests

Detail information pertinent to any individual source is put together in the form of "Source Digest". The information for each source relates to (a) location and accessibility, (b) physiographic and geologic conditions, (c) environmental appraisal, (d) extent of investigations conducted, (e) summary results of investigations, (f) principal evaluations, and (g) recommendations. The source digests are organized alpha-numerically for efficient tracking of information.

The information provided in the respective source digests form basis for the analyses and procurement plans.

Seventeen (17) sources were studied in Muzaffarabad, recommendation of these sources is presented in this report. For recommended usage refer recommendations **Table 5.1** for coarse aggregate.

5.7 Suitability of the Investigated Sources

A careful evaluation of the Seventeen (17) investigated sources was conducted to establish their suitability in broad terms as construction material. The evaluation was made in strict compliance to the criteria stated in Chapter 4. A summary of the evaluation results is given below:

- 1 Twelve (12) rock sources have been rated as suitable for quarrying coarse aggregate for producing (a) concrete of varying strength, (b) asphalt road works, and (c) base/sub-base road elements. These sources are located in the vicinity of Muzaffarabad city, Lamnian, Chakhama, Nauseri and Balgran etc. The rocks comprising these sources include limestone, dolomite, meta-sediments, meta-carbonates, metabasalt (Greenstone) and dolerite. These sources are also suitable for quarrying stone for masonry works.

CONSTRUCTION MATERIAL SOURCES IN AND AROUND AZAD JAMMU & KASHMIR
TABLE 5.1
 Recommended Uses of Various Material Sources in Districts Muzaffarabad

QUARRY NAME	Source Code	STRUCTURES WITH LESS LIFE RISK																								ROADS			
		Private Houses and Public Buildings (Schools, BHU, etc. of max. 2 storeys)				Major Public Buildings (Colleges, Hospitals and Bridges etc.)								Causeways		Culverts		Concrete		Masonry walls		Inter-district Roads		Intra-district Roads		Community Roads			
		Load Bearing Concrete Blocks (2000 Psi)	Lean Concrete	Concrete upto 2000 psi	Concrete 2000-4000 psi *	Stones	Non-Load Bearing Concrete Blocks	Load Bearing Concrete Blocks	Lean Concrete	Concrete upto 2000 psi	Concrete 2000-4000 psi *	High Strength Concrete *	Pre-stressed Concrete	Stone	Lean Concrete	Concrete Upto 3000 psi *	Stone	Lean Concrete	Concrete upto 3000psi *	Lean Concrete	Concrete (Upto 3000 psi) *	Stones	Lean Concrete	Concrete (3000 psi) *	Base / Sub Base	Asphalt Layer	Sub Base / Soling	Asphalt Layer	Soling
Kamsar Dolomitic Limestone Quarry ^(a)	MZ1	✓	✓	✓	✓	×	✓	✓	✓	✓	×	×	×	×	✓	✓	✓	×	✓	✓	×	✓	✓	✓	×	✓	×	✓	×
Kamsar Dolomite Quarry ^(b)	MZ2	✓	✓	✓	×	×	✓	✓	✓	✓	×	×	×	×	✓	✓	×	✓	✓	✓	✓	×	✓	✓	✓	✓	✓	✓	✓
Margalla Limestone ^(c) (At Yadgar, Batmong, Hill Seri Dera and Zahid Chowk localities)	MZ3	✓	✓	✓	✓	✓	✓	✓	✓	✓	▲	▲	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Niazpura Dolomitic Limestone Quarry ^(d)	MZ6	✓	✓	✓	×	✓	✓	✓	✓	✓	×	×	×	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Chattar Kalas Nullah Gravel ^(g)	MZ10	✓	✓	✓	×	✓	✓	✓	✓	✓	×	×	×	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	×	✓	×	✓	×
Komi Kot Sandstone Quarry ⁽ⁱ⁾	MZ18	✓	✓	✓	×	✓	✓	✓	✓	✓	×	×	×	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	×	✓	×	✓	×
Balgran Volcanics (Meta basalt)	NM-12MZ	✓	✓	✓	×	✓	✓	✓	✓	✓	×	×	×	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	×	✓	×	✓	×
Dhara Balgran Meta Carbonates	NM-13MZ	✓	✓	✓	✓	✓	✓	✓	✓	✓	×	×	×	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Suitable ✓ Project Specific Studies including Mix Design ▲ Not Suitable ×

The recommendations are based on the presumption that the available cement type in the State is Ordinary Portland Cement.

Requires Mix Design in Recommended Case *

CONTINUED ON NEXT PAGE

CONSTRUCTION MATERIAL SOURCES IN AND AROUND AZAD JAMMU & KASHMIR
TABLE 5.1

Recommended Uses of Various Material Sources in Districts Muzaffarabad and Hattian

NOTES:

1. (a) The source indicated is suitable for 2000~4000psi concrete classes only if no mixing of the overlying dolomite unit is guaranteed. To avoid such mixing a well planned quarry and strict quality control under the supervision of qualified and experienced technical staff is required. The source is not recommended for stone as the brecciated nature of rock will not allow extraction of such large sizes.
2. (b) The source rock contains invariably varied thick layers of cherty dolomite. Both constituents contaminate the aggregate derived from the source. The aggregate may or may not be ASR susceptible depending on the contaminant percentage.
3. (c) Invariable distributed beds in the source are relatively weak in strength. It is not recommended to use this source either in high strength concrete or road making aggregate. This could only be possible if project oriented selective quarrying of only the hard beds under strict quality control is made.
4. The sources with superscripts (b,d,e,f,g,h,i & j) are reactive in terms of ASR. The recommended usage in concrete requires that total alkalis from all sources do not increase the threshold value of 2.5 kg per cubic meter of concrete.
5. Material suitability of very high strength and prestressed concrete shall be established on the basis of actual concrete mix design and project specific studies.
7. The sources having ASR susceptibility can be used for concrete with following options:
i). Using Low Alkali Cement (Alkalis as Na₂O less than 0.4%) ii). Using Slag blended Cement or Pozzolanic Cement iii). Using Slag, Fly Ash or Silica Fume as Partial Replacement with the OPC
8. (c) Yadgar limestone shows variation in LAA, TFV and other mechanical test required for road wearing course. It is recommended that project based studies should be carried out if the source is used for asphalt concrete.
9. The usage of stone dust from sandstone/sandy gravel source should be avoided for the road construction.
10. The gravel sources meet the requirement of base course. However, the usage as Aggregate Base Course will require to meet the specifications of crushed and rounded faces. This will be achieved through proper crushing technique. Aggregate Base Course should meet the requirement of more than 90% two faced crushed aggregate.
11. The local limited exposures of Murree Formations if encounter during road cutting and project excavation and having properties similar to the identified sandstone sources, the above recommendations shall also prevail for this material.

Sample Location Map, District Muzaffarabad

Figure-5.4

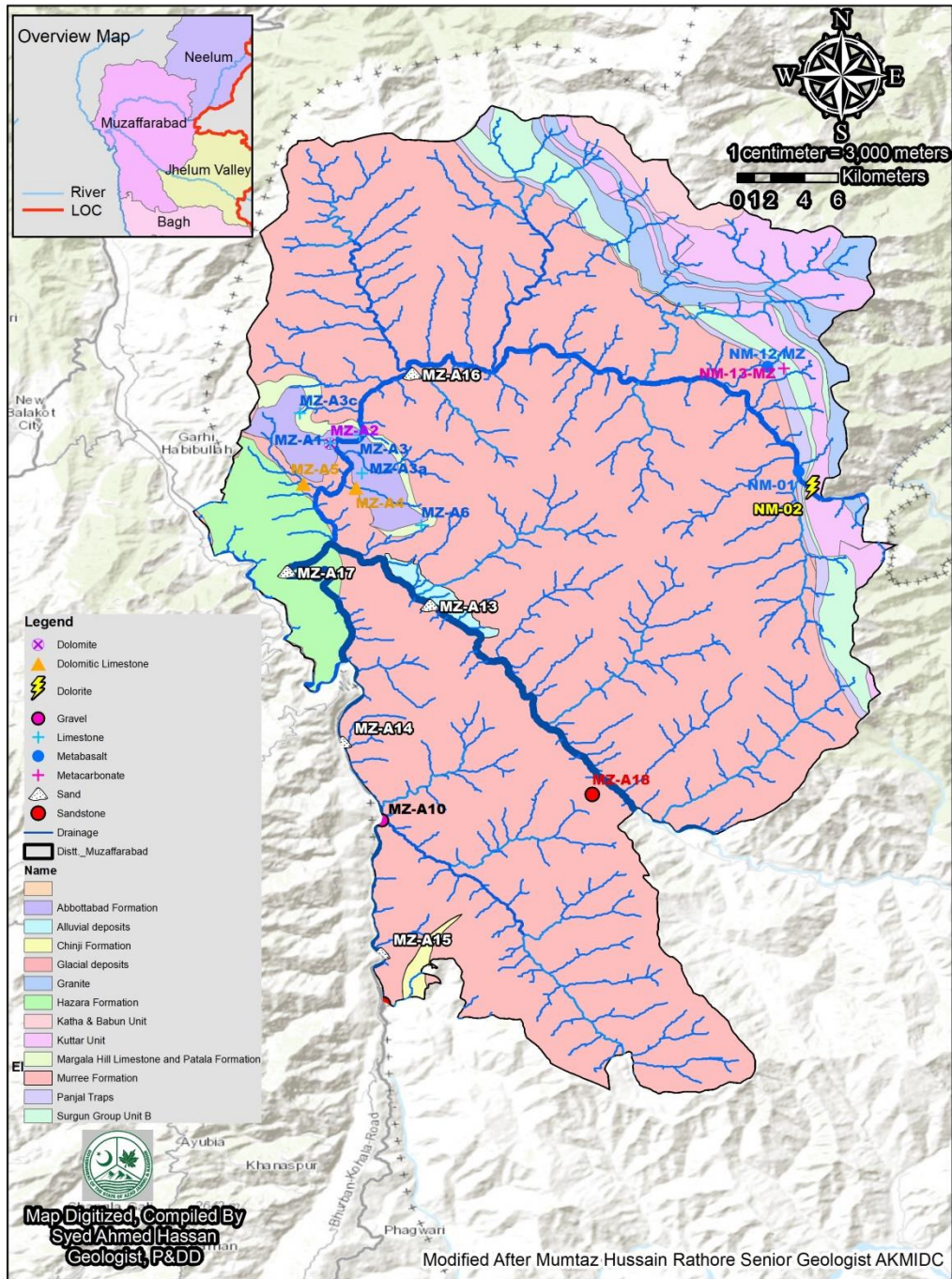


Figure 5.4: Sample Location Map of District Muzaffarabad

- 2 Three (03) sandstone sources and one (01) nullah bed gravel source have been rated as suitable for quarrying stone for various masonry works and soling material for road works. These sources are located in Komikot, Kohala, and Chatter Kalas
- 3 Yadgar Batmang Margalla Limestone material is locally used. Margalla Limestone is also exposed at Hill Seri Dera and Zahid Chowk localities of districts Muzaffarabad and Jhelum Valley.
- 4 Keeping in view the local scenario, safety and requirements the similar grey, strong small sandstone exposures of Murree Formation not fall in the source criteria have been rated as suitable for quarrying stone for various masonry works and soling material for road works at various localities of district Muzaffarabad.
- 5 Five (05) riverbed sand sources have been rated as suitable for low-strength concrete production. These sources are located near Challpani, Langerpura, Thori, Dullai, and Barsala.
- 6 A source of naturally crushed dolomite in Muzaffarabad city; known as Makri Bela quarry and presently being quarried unofficially, is recommended to be banned on account of serious risks for life and property. A similar potential source in the vicinity near Showai is also discarded on the same account.
- 7 The local limited exposures of Murree Formation having characteristics similar to the identified sources, the recommendations presented in Table 5.1 for this material shall also prevail. Such material may encounter during road cutting and project excavations.

5.8 Recommended Uses of Suitable Sources

The sources declared suitable have varying petrographic, physical and engineering characteristics. A cautious evaluation of the characteristics of each source was carried out to identify its appropriate uses as construction material in light of the Composite Schedule of Rates, AJ&K.

Based on this evaluation, the recommended uses of all the sources for various construction types are indicated in Table 5.1. A summary of detailed laboratory testing is also presented in this report. Necessary precautions for quarrying, borrowing and individual petrographic test results from these sources are presented in respective "Source Digest." Considering the difficult topographic conditions of the area for transport the material downhill, construction of chutes/conveyor belt system is recommended for quarry development.

5.9 Quantitative Estimate of Material Availability

The sources declared suitable have varying quantities of quarry-able material that are mentioned in the respective source digests and **Table 5.2**. A quick appraisal of the available sources and their recommended uses have brought forward following major inferences:

- 1 The district is self-sufficient in (a) coarse aggregate required for low-strength concrete works, and (b) masonry stone.
- 2 The district is in surplus of the material including (a) coarse aggregate for asphalt works, and (b) base/ sub-base material for road construction.

- 3 The district is deficient in coarse aggregate required for high-strength concrete, and no fine aggregate source is identified in the districts for high-strength concrete. The above inferences are made in broader terms and can be used for developing material procurement plan for districts Muzaffarabad and other adjacent districts.

CONSTRUCTION MATERIAL SOURCES IN AND AROUND AZAD JAMMU & KASHMIR

Table 5.2

Proposed Quarrying Method and Estimated Quarryable Material Quantities in District Muzaffarabad

Source Designation and Title		Quarrying Method		Estimated Quarryable Quantity (10 ⁶ x m ³)
		Existing	Proposed	
MZ-1	Kamsar Dolomitic Limestone	Conventional Full Face	Existing to be continued and chute design is recommended	0.5
MZ-2	Kamsar Dolomite	Conventional Full Face	Existing to be continued and chute design is recommended	20
MZ-3	Yadgar-Batmang Limestone	Conventional Full Face	Existing to be continued and chute design is recommended	5.0
MZ-6	Niazpura Dolomitic Limestone	No Quarry Activity	Conventional and chute design is recommended	5.0
MZ18	Komi Kot Sandstone Quarry ⁽ⁱ⁾	No Quarry Activity	Conventional and chute design is recommended	3.0
MZ 12	Balgran Volcanics (Meta basalt)	No Quarry Activity	Conventional and chute design is recommended	9
MZ 13	Dhara Balgran Meta Carbonates	No Quarry Activity	Conventional and chute design is recommended	2.0

CHAPTER 6

CONSTRUCTION MATERIAL SOURCES STUDY OF DISTRICT JHELUM VALLEY

6.1 General

Comprehensive construction material study of district Jhelum Valley, AJ&K was conducted in accordance with the Terms of Reference and the work methodology stated in the previous chapters. The study included assessment of area potential, identification of all existing and potential sources, qualitative/ quantitative evaluation, and accordingly determining their suitability for use as construction material for buildings, roads and bridges.

This chapter provides details of explorations, evaluations, and suitability assessments of all source's studies in district Jhelum Valley. The adequacy of construction material on district level is also discussed which would serve as a realistic base for preparing material procurement plan for the district.

6.2 Administrative Setup and Physiography

District Jhelum Valley extends over an area of 854km², which hosts a population of about 854,259 persons (2017 Census). It shares inter-district boundaries with Bagh district in south. In the west, it is bounded by District Muzaffarabad, while in the east & north is bordered by "Line of Control" with India.

The district comprises three tehsils, Hattian Bala, Chikar and Karnah. Hattian Bala city is the district headquarters. The other tehsil headquarters are Leepa and Chikar towns. The other main towns include Chikoti, Chinari, Chikar, Karnah, Lamnian and Reshian.

The district forms part of Lesser Himalayan Zone, and its topography is mainly mountainous with valleys in between. The elevation ranges from 580 m to 4440 m. Dao Khan is the major tourist spot in the district with elevation 9000 ft approx. High angle slopes and steep escarpments are prominent features of the area.

The district Jhelum Valley; is drained by Jhelum river and its tributaries. Lipa valley; 45 km in the southeast of Muzaffarabad city, is connected with a fair-weather road passing over Reshian Gali at elevation 3200 m. Lipa valley drains across the Line of Control.

The climate within the district varies greatly with altitude. The snowline in winters and summers times is at elevations 1200 and 3300 m respectively. The northern part is very cold in winter and moderate in summer, while the southern remains cold in winter and warm in summer. May, June and July are the hottest months, while December, January and February are the coldest months.

Hattian Bala, the district headquarter, is 181 and 221 km from Rawalpindi via Murree and Abbottabad respectively.

Fig. 6.1 shows the administrative and physiographic details of district Jhelum Valley.

6.3 Geology

Jhelum Valley; situated in the axial zone of Hazara-Kashmir syntaxis, comprises part of the Lesser Himalayas. The syntaxis exhibits two major thrusts, including Panjal Thrust (PT) and Main Boundary Thrust (MBT) in the north and south respectively. These thrusts

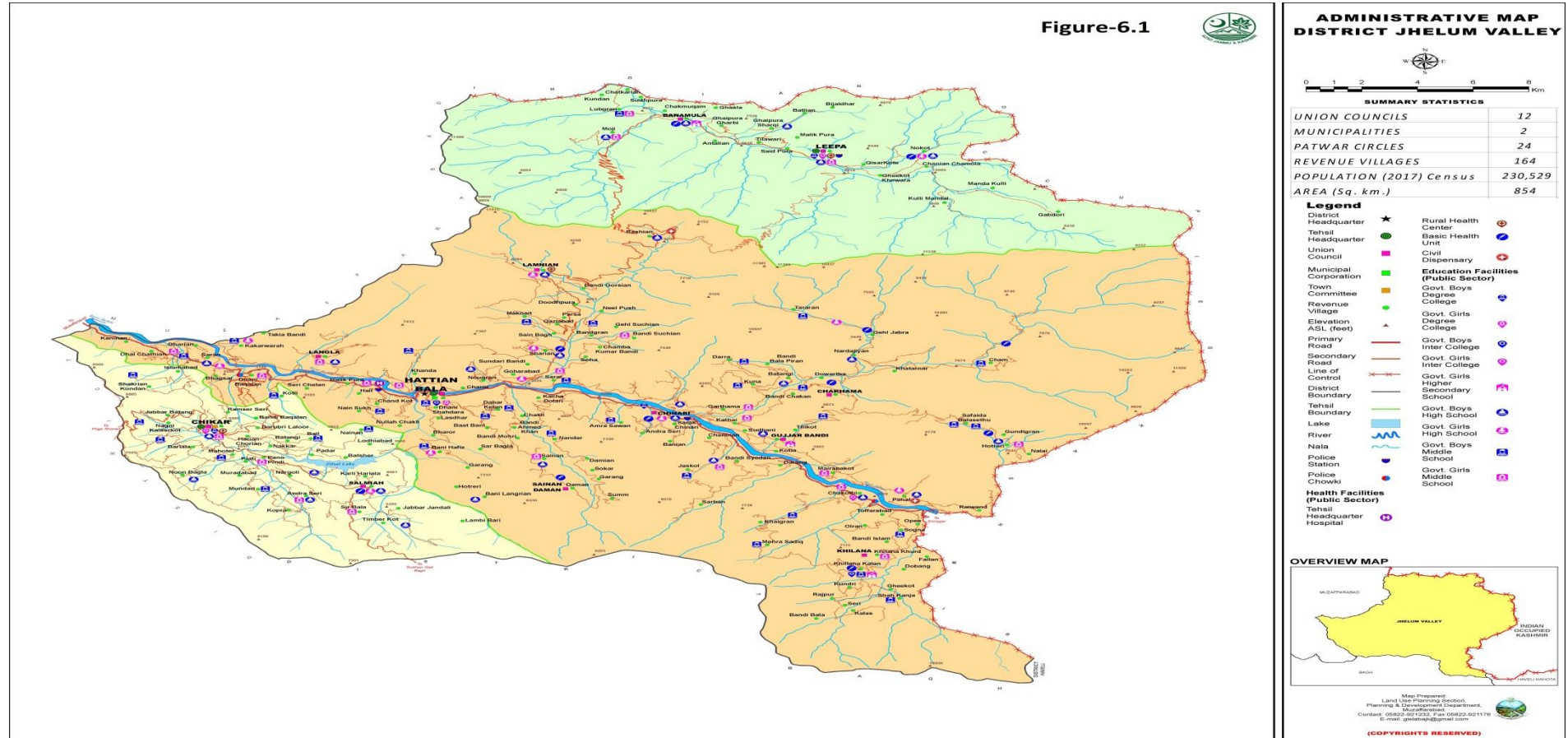


Figure 6.1: Administrative Setup of District Jhelum Valley

have developed three distinct geologic domains within the study area with respect to their relative position within the syntaxis and geologic formations. These domains include (a) the area north of Panjal Thrust comprising older metamorphic rocks, (b) the area between Panjal and MBT comprising volcanic and meta-sediments, and (c) the area south of MBT mostly comprising molassic rocks. The molassic rocks comprise siltstone, sandstone and shale of early Miocene age.

In addition to the above, the areas forming major valley floors, which are mostly covered with thick terrace deposits comprising gravel and boulders embedded in clayey silt matrix. The hill slopes at places covered with colluviums of varying thicknesses. A simplified geological map is presented as **Fig. 6.2**.

6.4 Construction Material Prospecting

The geologic formations exposed within district were carefully evaluated for their potential with respect to procurement of material for construction of buildings, bridges and roads. For this purpose, the geologic formations were categorized with respect to the broad engineering characteristics of various rock types. A map showing construction material prospects within the districts was prepared on the basis of this categorization, which is presented in **Fig. 6.3**. A summary of the inferences derived from this simplified map is presented below:

- The geologic formations exposed in 25% of the area have no prospect for concrete and asphalt aggregate as well as other major construction material required. These formations include Patala, Hazara and Salkhala.
- Murree and Kamli Formation (Rawalpindi Group) cover almost 69% of the total districts area. These formations comprise sandstone and alternating beds of siltstone and shale. The siltstone and shale beds form more than two third of the geologic formation, however, they have no prospect usage as construction material. On the other hand, the sandstone beds are recognized as having marginal prospect depending upon the hardness and joint frequency of the individual beds.
- Geologic formations; having relatively higher potential for serving construction material; occupy only 3% area of the entire districts. These formations include Panjal Volcanic and associated sills/dykes and meta-sediments.
- Nearly 3% of the area is covered with Quaternary deposits comprising mainly flood plain and terrace deposits, etc. Amongst these, only flood plain deposits have some prospects for construction material depending upon the rocks exposed in the stream catchments.

6.5 Exploration of Construction Material Sources

A comprehensive exploration program for identifying material suitable for use in construction of buildings, roads and bridges was executed in the district. The program was based on the local physiographic conditions, assessment of geology and material prospecting, existing sources, relevant deficiencies and State needs. The program activities included systematic identification of sources, preliminary field demarcations and assessments, comprehensive sampling, qualitative assessments, rapid environmental examination and quantitative assessments.

These activities were conducted in accordance with the criteria and methodology stated in the previous sections. A summary of the exploration program is given below:

Geological Map of District Jhelum Valley Figure-6.2

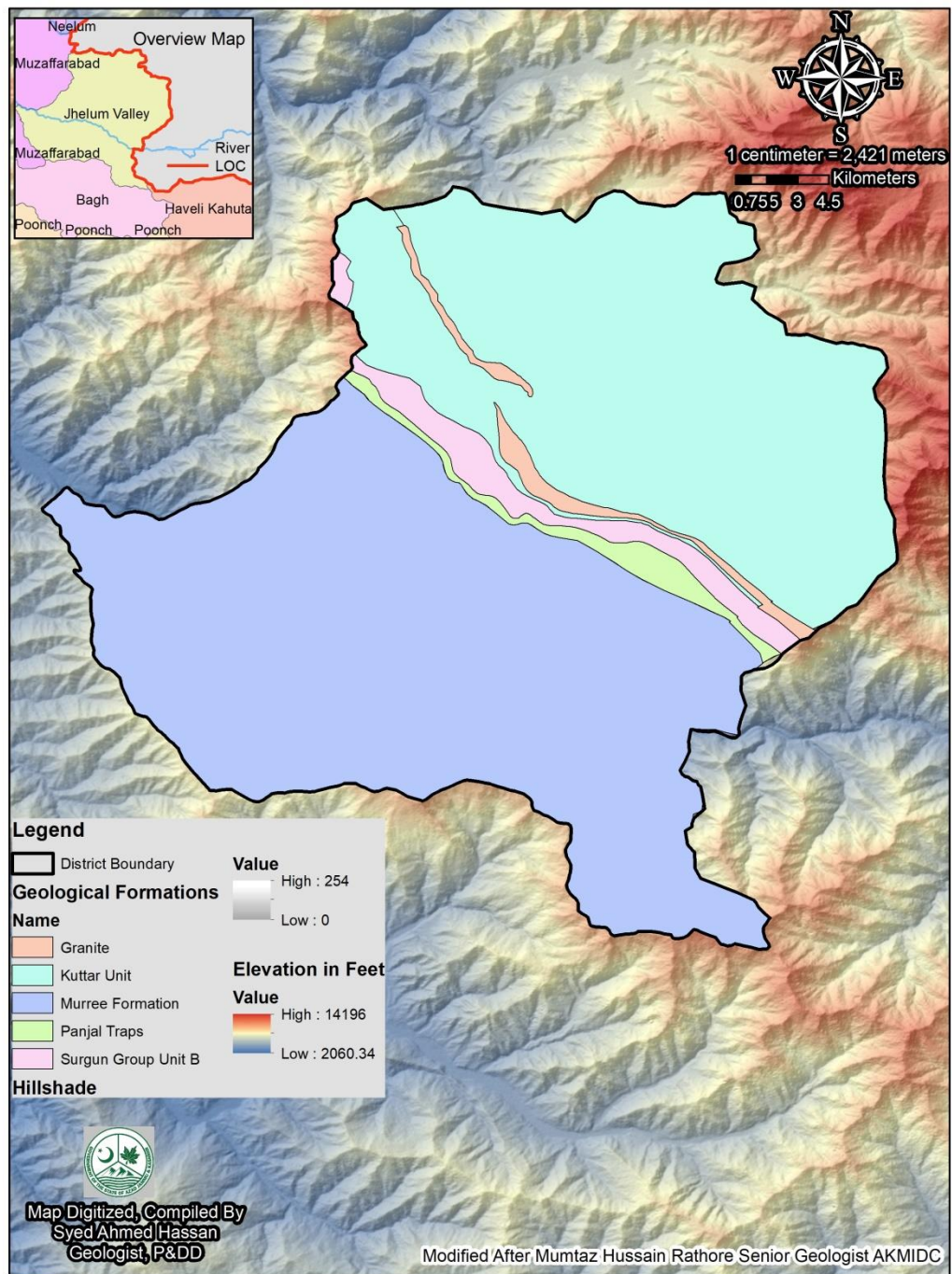


Figure 6.2: Geological Map of District Jhelum Valley

%age area Distribution of Geological Formations
w.r.t Construction Material Prospect
District Jhelum Valley

Figure 6.3

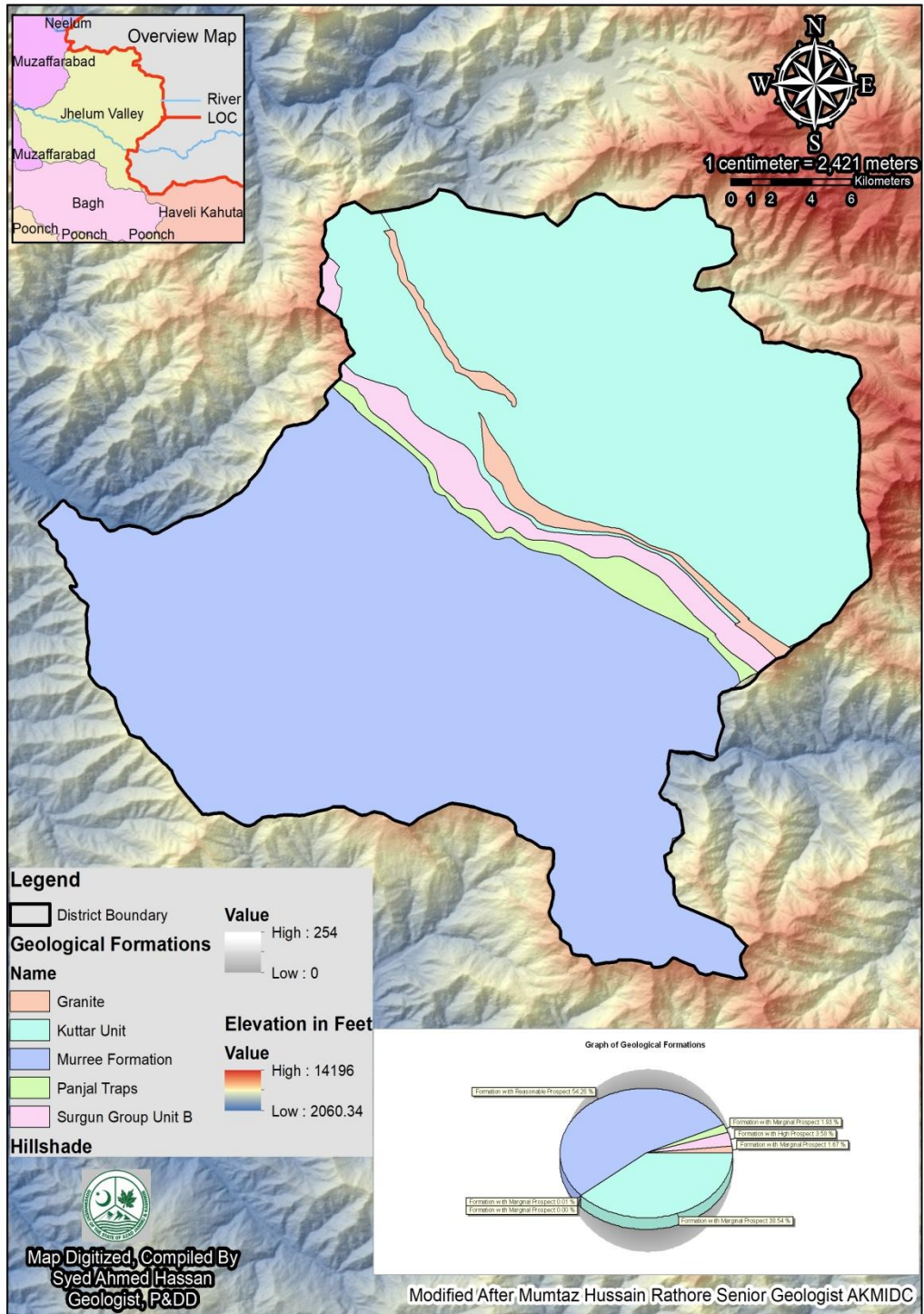


Figure 6.3: Construction Material Prospect Distribution of District Jhelum Valley

- 1 Eight (8) sources were identified and studied within the district. Amongst which 4 were evaluated as potential sources for coarse aggregate, base/sub-base material, and stones, while the rest were evaluated as potential sources for fine aggregate. Locations of all these sources are shown in **Fig. 6.4**.
- 2 Rapid environmental examination of all the sources was conducted in the very beginning of the exploration. Moreover, a comprehensive review of the existing quarrying techniques and material procurement procedures was carried out.
- 3 Hand samples were collected from these sources, out of which representative samples were analyzed through petrographic microscope after preparing thin sections. Set of petrographic analysis results for each source was evaluated with respect to perspective usages of the material.
- 4 Bulk samples were collected from these sources and were analyzed for physical properties at the Central material Testing Laboratory, WAPDA and Road Research Institute, C&W Department, Government of Punjab. The testing program was prepared considering the expected uses of the material and laboratory test results were accordingly evaluated.

6.6 Source Digests

Detail information pertinent to any individual source is put together in the form of "Source Digest". The information for each source relates to (a) location and accessibility, (b) physiographic and geologic conditions, (c) environmental appraisal, (d) extent of investigations conducted, (e) summary results of investigations, (f) principal evaluations, and (g) recommendations. The source digests are organized alpha-numerically for efficient tracking of information.

The information provided in the respective source digests form basis for the analyses and procurement plans.

Eight (8) sources were studied in the district, recommendation of these sources is presented in this report. For recommended usage refer recommendations Table 6.1 for coarse aggregate.

6.7 Suitability of the Investigated Sources

A careful evaluation of the Eight (8) investigated sources was conducted to establish their suitability in broad terms as construction material. The evaluation was made in strict compliance to the criteria stated in Chapter 4. A summary of the evaluation results is given below:

- 1 Fifteen (2) rock sources have been rated as suitable for quarrying coarse aggregate for producing (a) concrete of varying strength, (b) asphalt road works, and (c) base/ sub-base road elements. These sources are located in the vicinity of Muzaffarabad city, Lamnian, Chakhama, Nauseri and Balgran etc. The rocks comprising these sources include limestone, dolomite, meta-sediments, meta-carbonates, metabasalt (Greenstone) and dolerite. These sources are also suitable for quarrying stone for masonry works.
- 2 Three (02) sandstone sources and one (01) nullah bed gravel source have been rated as suitable for quarrying stone for various masonry works and soling material for road works. These sources are located in Lamnian, Chinari and Chakhama.

- 3 Keeping in view the local scenario, safety and requirements the similar grey, strong small sandstone exposures of Murree Formation not fall in the source criteria have been rated as suitable for quarrying stone for various masonry works and soling material for road works at various localities of district Jhelum Valley.

Sample Location Map of District Jhelum Valley Figure 6.4

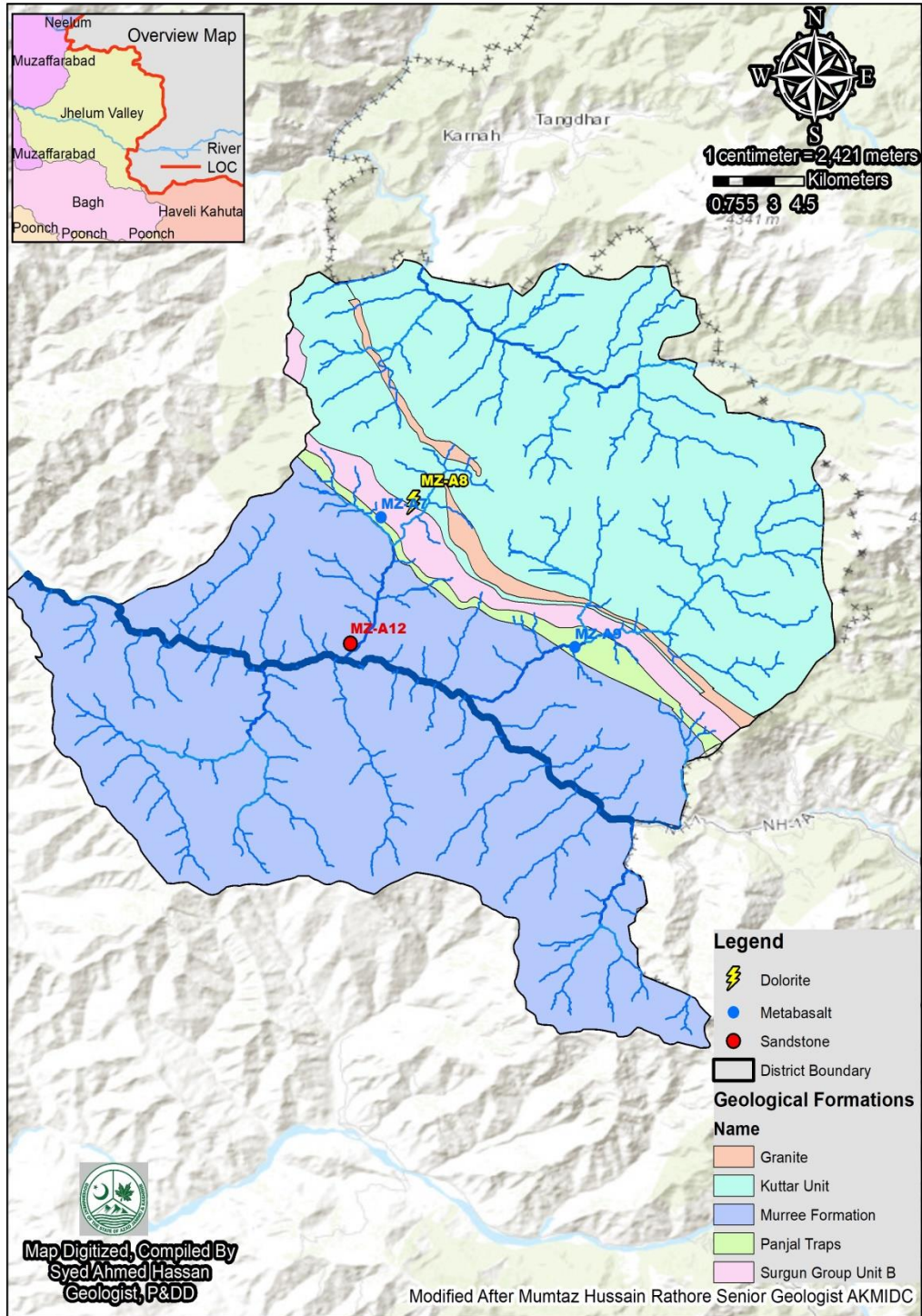


Figure 6.4: Sample Location of District Jhelum Valley

- 4 A source of naturally crushed dolomite in Muzaffarabad city; known as Makri Bela quarry and presently being quarried unofficially, is recommended to be banned on account of serious risks for life and property. A similar potential source in the vicinity near Showai is also discarded on the same account same material is being transported to District Jhelum Valley.
- 5 The granite, granite gneiss and quartz mica schist exposed at Reshian to Lipa section is recognized as having prospect (suitable) for dry stone masonry but not for hydraulic structures and concrete works.
- 6 The local limited exposures of Murree Formation having characteristics similar to the identified sources, the recommendations presented in Table 6.1 for this material shall also prevail. Such material may encounter during road cutting and project excavations.

6.8 Recommended Uses of Suitable Sources

The sources declared suitable have varying petrographic, physical and engineering characteristics. A cautious evaluation of the characteristics of each source was carried out to identify its appropriate uses as construction material in light of the Composite Schedule of Rates, AJ&K.

Based on this evaluation, the recommended uses of all the sources for various construction types are indicated in **Table 6.1**. A summary of detailed laboratory testing is also presented in this report. Necessary precautions for quarrying, borrowing and individual petrographic test results from these sources are presented in respective "Source Digest." Considering the difficult topographic conditions of the area for transport the material downhill, construction of chutes/conveyor belt system is recommended for quarry development.

6.9 Quantitative Estimate of Material Availability

The sources declared suitable have varying quantities of quarry-able material that are mentioned in the respective source digests and **Table 6.2**. A quick appraisal of the available sources and their recommended uses have brought forward following major inferences:

- 1 The district is self-sufficient in (a) coarse aggregate required for low-strength concrete works, and (b) masonry stone.
- 2 The district is in surplus of the material including (a) coarse aggregate for asphalt works, and (b) base/ sub-base material for road construction.
- 3 The district is deficient in coarse aggregate required for high-strength concrete because of non-availability of active quarry, and no fine aggregate source is identified in the district for high-strength concrete.

The above inferences are made in broader terms and can be used for developing material procurement plan for district Jhelum Valley and other adjacent districts.

CONSTRUCTION MATERIAL SOURCES IN AND AROUND AZAD JAMMU & KASHMIR
TABLE 6.1

Recommended Uses of Various Material Sources in District Hattian

QUARRY NAME	Source Code	STRUCTURES WITH LESS LIFE RISK																				ROADS									
		Private Houses and Public Buildings (Schools, BHU, etc. of max. 2 storeys)				Major Public Buildings (Colleges, Hospitals and Bridges etc.)								Causeways		Culverts		Concrete		Masonry walls		Inter-district Roads		Intra-district Roads		Community Roads					
		Load Bearing Concrete Blocks (2000 Psi)	Lean Concrete	Concrete upto 2000 psi	Concrete 2000-4000 psi *	Stones	Non-Load Bearing Concrete Blocks	Load Bearing Concrete Blocks	Lean Concrete	Concrete upto 2000 psi	Concrete 2000-4000 psi *	High Strength Concrete *	Pre-stressed Concrete	Stone	Lean Concrete	Concrete Upto 3000 psi *	Stone	Lean Concrete	Concrete upto 3000psi *	Lean Concrete	Concrete (Upto 3000 psi) *	Stones	Lean Concrete	Concrete (3000 psi) *	Base / Sub Base	Asphalt Layer	Sub Base / Soling	Asphalt Layer	Soling	Asphalt Layer	
Lamnian Meta-basalt Quarry ^(e)	MZ7	✓	✓	✓	×	✓	✓	✓	✓	✓	×	×	×	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	×	✓	×	✓	×		
Lamnian Dolorite Quarry	MZ8	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	▲	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Chakhama Meta-basalt Quarry ^(f)	MZ9	✓	✓	✓	×	✓	✓	✓	✓	✓	×	×	×	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	×	✓	×	✓	×			
Eren Sandstone Quarry ^(h)	MZ11	✓	✓	✓	×	✓	✓	✓	✓	✓	×	×	×	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	×	✓	×	✓	×			
Sandri Bandi Sandstone Quarry ⁽ⁱ⁾	MZ12	✓	✓	✓	×	✓	✓	✓	✓	✓	×	×	×	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	×	✓	×	✓	×			
Suitable ✓		Project Specific Studies including Mix Design ▲										Not Suitable ×																			
The recommendations are based on the presumption that the available cement type in the State is Ordinary Portland Cement.																															
Requires Mix Design in Recommended Case *																															
CONTINUED ON NEXT PAGE																															

CONSTRUCTION MATERIAL SOURCES IN AND AROUND AZAD JAMMU & KASHMIR

TABLE 5.1

Recommended Uses of Various Material Sources in Districts Muzaffarabad and Hattian

NOTES:

1. (a) The source indicated is suitable for 2000–4000psi concrete classes only if no mixing of the overlying dolomite unit is guaranteed. To avoid such mixing a well planned quarry and strict quality control under the supervision of qualified and experienced technical staff is required. The source is not recommended for stone as the brecciated nature of rock will not allow extraction of such large sizes.
2. (b) The source rock contains invariably varied thick layers of cherty dolomite. Both constituents contaminate the aggregate derived from the source. The aggregate may or may not be ASR susceptible depending on the contaminant percentage.
3. (c) Invariable distributed beds in the source are relatively weak in strength. It is not recommended to use this source either in high strength concrete or road making aggregate. This could only be possible if project oriented selective quarrying of only the hard beds under strict quality control is made.
4. The sources with superscripts (b,d,e,f,g,h,i & j) are reactive in terms of ASR. The recommended usage in concrete requires that total alkalis from all sources do not increase the threshold value of 2.5 kg per cubic meter of concrete.
5. Lamnian quarries are recommended for the local all purposes uses. The transportation outside the valley will not be economical.
6. Material suitability of very high strength and prestressed concrete shall be established on the basis of actual concrete mix design and project specific studies.
7. The sources having ASR susceptibility can be used for concrete with following options:
 i). Using Low Alkali Cement (Alkalis as Na_2O less than 0.4%) ii). Using Slag blended Cement or Pozzolanic Cement iii). Using Slag, Fly Ash or Silica Fume as Partial Replacement with the OPC
9. The usage of stone dust from sandstone/sandy gravel source should be avoided for the road construction.
10. The gravel sources meet the requirement of base course. However, the usage as Aggregate Base Course will require to meet the specifications of crushed and rounded faces. This will be achieved through proper crushing technique. Aggregate Base Course should meet the requirement of more than 90% two faced crushed aggregate.
11. The local limited exposures of Murree Formations if encounter during road cutting and project excavation and having properties similar to the identified sandstone sources, the above recommendations shall also prevail for this material.

CONSTRUCTION MATERIAL SOURCES IN AND AROUND AZAD JAMMU & KASHMIR

Table 6.2

Proposed Quarrying Method and Estimated Quarryable Material Quantities in District Hattian

Source Designation and Title		Quarrying Method		Estimated Quarryable Quantity (10 ⁶ x m ³)
		Existing	Proposed	
MZ-7	Lamnian Metabasalt	No Quarry Activity	Conventional and chute design is recommended	7.0
MZ-8	Lamnian Dolerite	No Quarry Activity	Conventional and chute design is recommended	7.0
MZ-9	Chakhama Metabasalt	No Quarry Activity	Conventional and chute design is recommended	12.0
MZ-11	Eran Sandstone	No Quarry Activity	Conventional and chute design is recommended	8.0
MZ-12	Sundari Bandi Sandstone	No Quarry Activity	Conventional and chute design is recommended	2.0

CHAPTER 7

CONSTRUCTION MATERIAL SOURCES STUDY OF DISTRICT BAGH

7.1 General

Districts Bagh was also included in the Pilot Phase of the study and investigations were conducted concurrently with the districts Muzaffarabad and Jhelum Valley sharing the similar investigation approach and activities.

This chapter provides details of explorations, evaluations, and suitability assessments of all source's studies in district Bagh. The adequacy of construction material on district level is also discussed which serves as a realistic basis for preparing material procurement would plan for both the districts.

7.2 Administrative Setup and Physiography

Districts Bagh extend over an area of 1,368 km², which hosts a population of about 371,919 persons (2017 Census). It shares inter-district boundaries with Muzaffarabad and Poonch districts in the north and south respectively. In the west, it is bounded by Punjab (Pakistan), while in the east is bordered by District Haveli.

The district Bagh comprises three tehsils, including Dhir Kot, Harighel and Bagh. The main towns of the district include Munasa, Hill Chaman Kot, Chamati, Kotli, Rangla, Malot, Kalspajay, Neelabut, Sesar, Chairala, Ghaziabad, Jhala, Arja, Dhal Qazian, Dulli and Mehmood Gali. All these towns are well connected through metaled roads.

The district form part of Lesser Himalayan Zone, and their topography is mainly mountainous with valleys in between. The elevation ranges from 520 meters to 2500 meters. Moderate to high angle slopes and steep escarpments are prominent features of the area. The mountain slopes are mostly covered with coniferous forests.

Dhir Kot, Harighel and Bagh tehsils drain into Jhelum river through Mahl river and other local tributaries.

The climate within the district varies greatly with altitude. The snowline in winters and summers times is at elevations 1200 m and 3300 m respectively. The eastern part of the districts is very cold in winters and moderate in summers, while the western part remains cold in winters and hot in summers. May, June and July are the hottest months, while December, January and February are the coldest months. The maximum and minimum temperature in the month of January varies between 30°C and 16°C, while the same in the month of June vary between 40°C and 22°C respectively. The annual precipitation rate is about 1500 millimeters.

Muzaffarabad city is located at a distance of about 100 km and 80 km from Bagh city via Kohala and Suddhen Gali route respectively. Islamabad is located at a distance of 166 and 178 km from Bagh city via Kohala and Rawalakot route respectively.

Fig. 7.1 shows the administrative and physiographic details of district Bagh.

7.3 Geology

District Bagh; situated in the western axial zone of Hazara-Kashmir syntaxis, comprises part of the Lesser Himalayas. The syntaxis exhibits two major thrusts, including Panjal Thrust (PT) and Main Boundary Thrust (MBT) in the north and south respectively. These

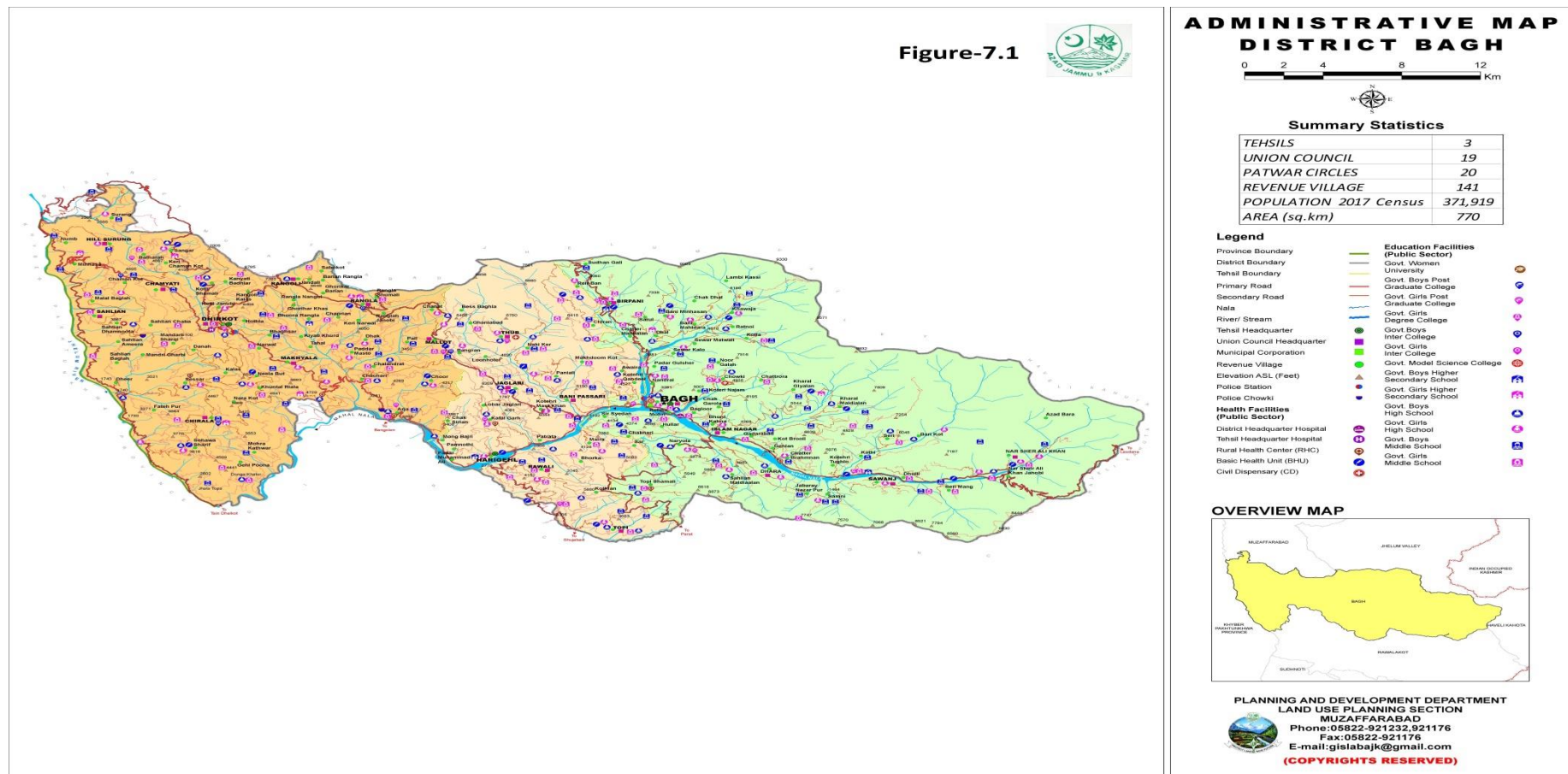


Figure 7.1: Administrative and Physiographic Details of District Bagh

thrusts have developed one distinct geologic domain within the study area with respect to their relative position within the syntaxis and geologic formations. These domains include the area south of MBT mostly comprising molassic rocks. The molassic rocks comprise siltstone; sandstone and shale of early Miocene age, are mostly exposed in Dhir Kot, Harighel and Bagh tehsils.

In addition to the above, the areas forming major valley floors which are mostly covered with thick terrace deposits comprising gravel and boulders embedded in clayey silt matrix. The hill slopes at places are covered with colluvium of varying thicknesses. A simplified geological map is presented as **Fig. 7.2**.

7.4 Construction Material Prospecting

The geologic formations exposed within district were carefully evaluated for their potential with respect to procurement of material for construction of buildings, bridges and roads. For this purpose, the geologic formations were categorized with respect to the broad engineering characteristics of various rock types. A map showing construction material prospects within the districts was prepared on the basis of this categorization, which is presented in **Fig. 7.3**. A summary of the inferences derived from this simplified map is presented below:

- Murree and Kamlial Formations cover almost 98% of the total district area. These formations comprise alternating beds of siltstone, shale and sandstone. The siltstone and shale beds form more than two third of the geologic formation, however, they have no prospect usage as construction material. On the other hand, the sandstone beds are recognized as having marginal potential depending upon the hardness and joint frequency of the individual beds.
- Nearly 2% of the area is covered with Quaternary deposits comprising mainly flood plain and terrace deposits, etc. Amongst these, only flood plain deposits have prospects for construction material depending upon the rocks exposed in the stream catchments.

7.5 Exploration of Construction Material Sources

A comprehensive exploration program for identifying material suitable for use in construction of buildings, roads and bridges was executed in the district. The program was based on the local physiographic conditions, assessment of geology and material prospecting, existing sources, relevant deficiencies and State needs. The program activities included systematic identification of sources, preliminary field demarcations and assessments, comprehensive sampling, qualitative and quantitative assessments and rapid environmental examination. These activities were conducted in accordance with the criteria and methodology stated in the previous sections. A summary of the exploration program is given below:

- 1 15 sources were identified and studied within in district. All sources were evaluated as potential sources for coarse aggregate, base/sub-base material, and stones, while the rest were evaluated as potential sources for fine aggregate. Locations of all these sources are shown in **Fig. 7.4**.
- 2 Rapid environmental examination of all the sources was conducted in the very beginning of the exploration. Moreover, a comprehensive review of the existing quarrying techniques and material procurement procedures was carried out.

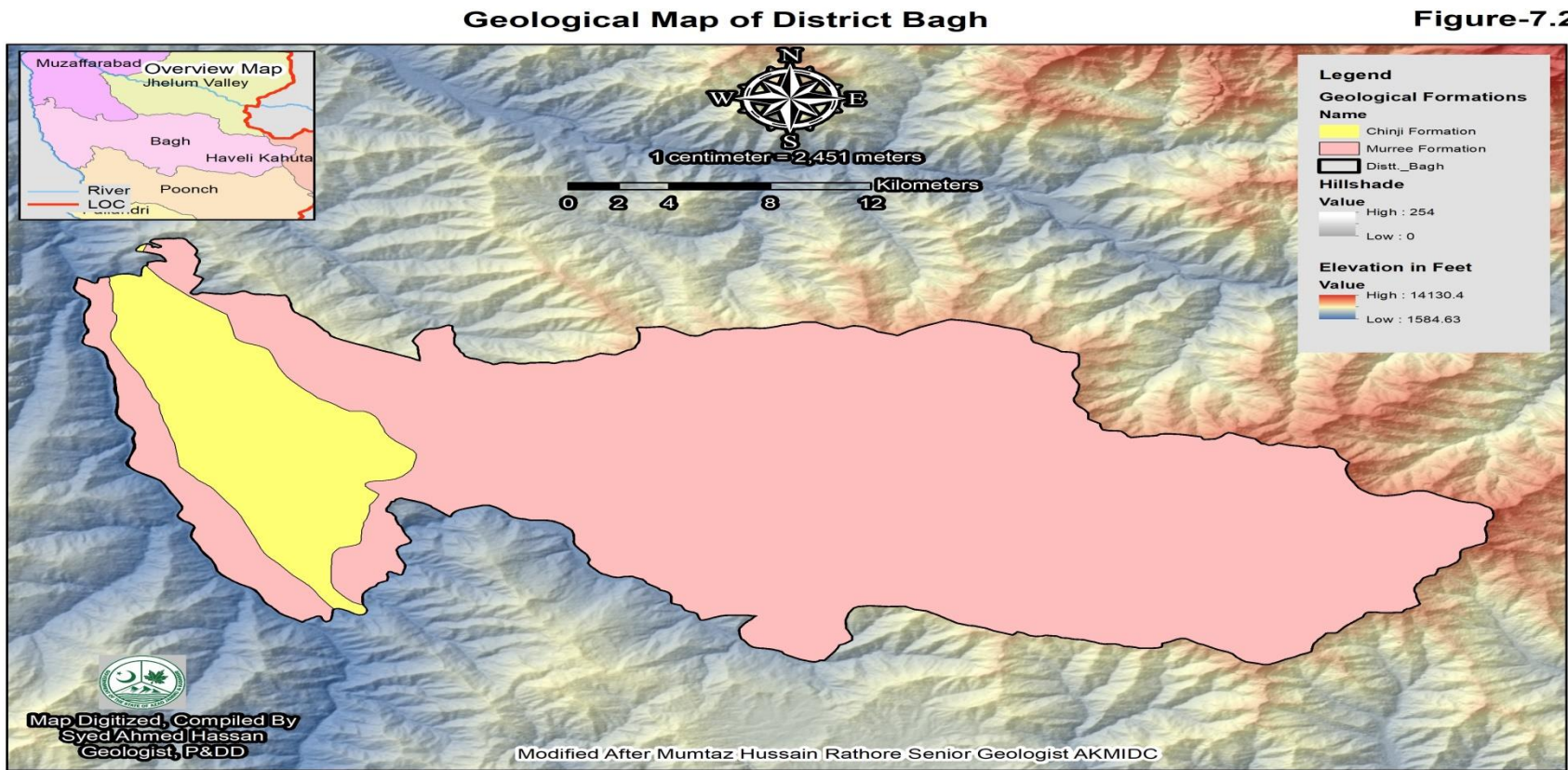


Figure 7.2: Geological Map of District Bagh

%age Area Distribution of Geological Formations w.r.t. Construction Material Prospects, Distirct Bagh Figure 7.3

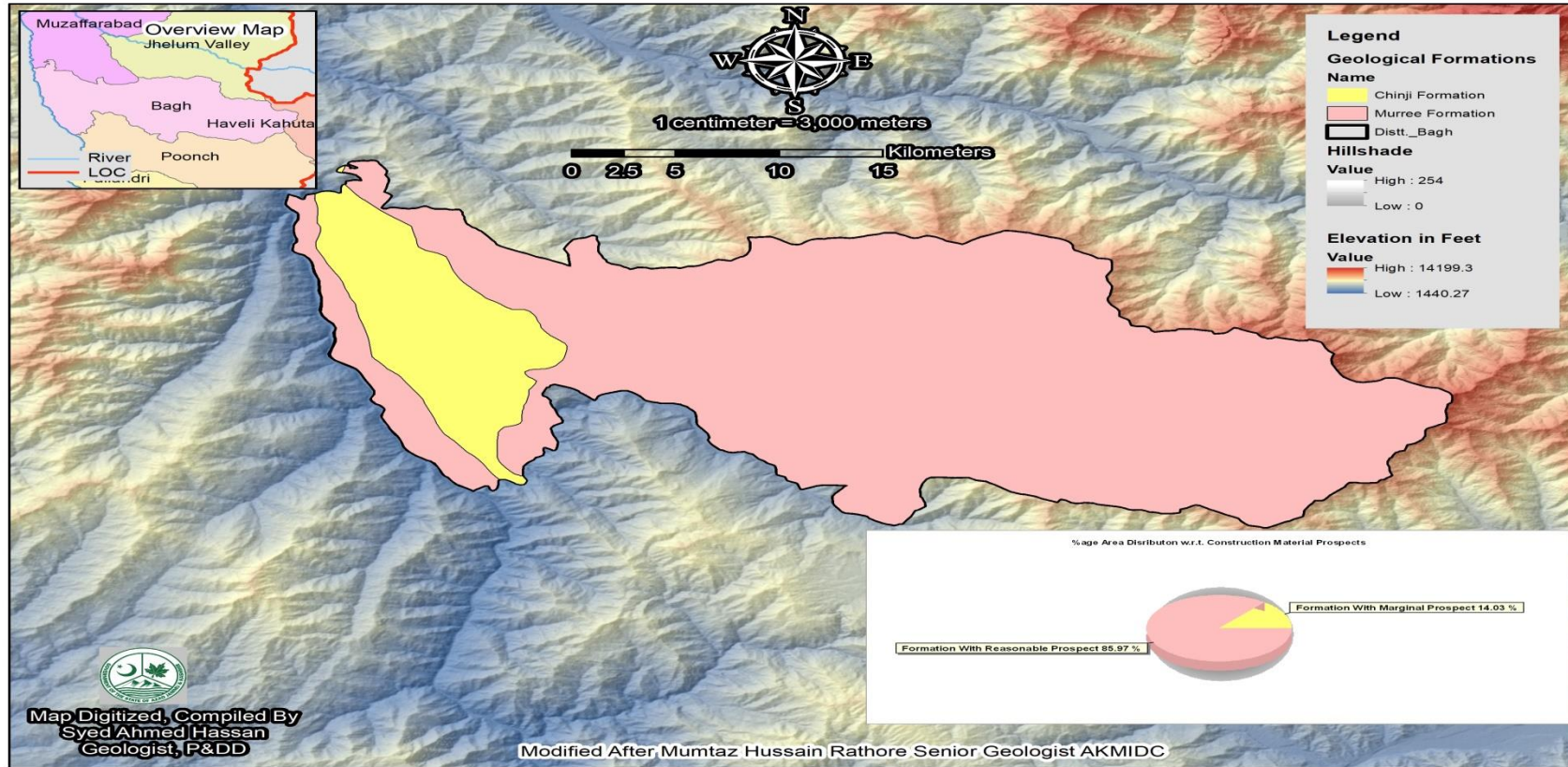


Figure 7.3: Construction Material Prospects of District Bagh

Sample Location Map, District Bagh

Figure-7.4

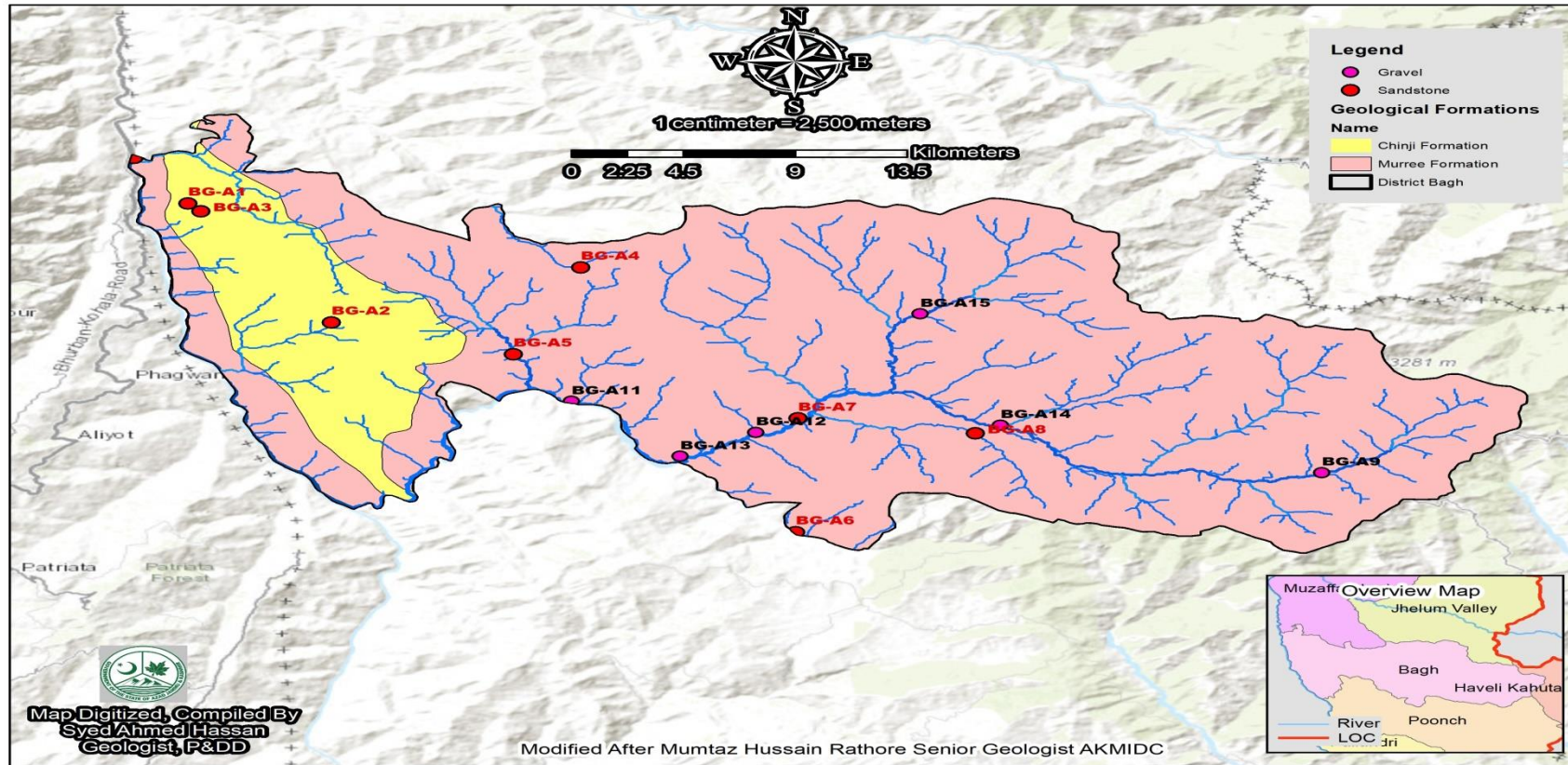


Figure 7.4: Sample Location Map of District Bagh

- 1 Hand samples were collected from these sources, out of which representative samples were analyzed through petrographic microscope after preparing thin sections. Set of Petrographic analysis results for each source were evaluated with respect to perspective usages of the material.
- 2 Bulk samples collected from these sources were analyzed for physical properties at the Central material Testing Laboratory, WAPDA and Road Research Institute, C&W Department, Government of Punjab. The testing program was prepared considering the expected uses of the material and laboratory test results were accordingly evaluated.

7.6 Source Digests

Detailed information pertinent to any individual source is put together in the form of "Source Digest". The information for each source relates to (a) location and accessibility, (b) physiographic and geologic conditions, (c) environmental appraisal, (d) extent of investigations conducted, (e) summary results of investigations, (f) principal evaluations, and (g) recommendations. The source digests are organized alpha-numerically for efficient tracking of information.

The information provided in the respective source digests form basis for the analyses and procurement plans.

Digests of nineteen (15) sources; as identified and studied within district, are being provided separately.

7.7 Suitability of the Investigated Sources

A careful evaluation of the 15 investigated sources was conducted to establish their suitability in broad terms as construction material. The evaluation was made in strict compliance to the criteria stated in Chapter 4. A summary of the evaluation results is given below:

- 1 Five (05) riverbed gravel sources have been rated as suitable for borrowing coarse aggregate for producing (a) concrete of low-strength (b) base/ sub-base road elements. These sources are located within the beds of (a) Mahl River (b) Malwani Kas and. The gravel and boulders of these sources mostly comprise of sandstone.
- 2 Seven (7) sandstone sources have been rated as suitable for quarrying stone for various masonry works, concrete of low-strength and soling material for road works. These sources are located throughout the tehsils of Dhir kot and Bagh.
 - The local limited exposures of Murree Formation having characteristics similar to the identified sources, the recommendations presented in **Table 7.1** for this material shall also prevail. Such material may encounter during road cutting and project excavations

Detailed comments concerning the suitability of each explored sources is made in the respective "Source Digest".

7.8 Recommended Uses of Suitable Sources

The sources declared suitable have varying petrographic, physical and engineering characteristics. A cautious evaluation of the characteristics of each source was carried out to identify its appropriate uses as construction material in light of the Composite Schedule of Rates for AJ&K. Based on this evaluation, the recommended uses of all the sources for various construction types are indicated in Table 7.1. Necessary precautions

CONSTRUCTION MATERIAL SOURCES IN AND AROUND AZAD JAMMU & KASHMIR
TABLE 7.1
 Recommended Uses of Various Material Sources in District Bagh

QUARRY NAME	Source Code	TYPE OF CONSTRUCTION																												
		STRUCTURES WITH GREATER LIFE RISK												STRUCTURES WITH LESS LIFE RISK						ROADS										
		Private Houses and Public Buildings (Schools, BHU, etc. maximum of two storeys)						Major Public Buildings (Colleges, Hospitals and Bridges etc.)						Causeways		Culverts		Concrete		Masonry walls		Inter-district Roads		Intra-district Roads		Community Roads				
		Stone	Non-Load Bearing Concrete Blocks	Load Bearing Concrete Blocks (2000 Psi)	Lean Concrete	Concrete upto 2000 psi	Concrete 2000-4000 psi *	Stones	Non-Load Bearing Concrete Blocks	Load Bearing Concrete Blocks	Lean Concrete	Concrete upto 2000 psi	Concrete 2000-4000 psi *	High Strength Concrete	Pre-stressed Concrete	Stone	Lean Concrete	Concrete (Upto 3000 psi) *	Stone	Lean Concrete	Reinforced Concrete (3000psi) *	Lean Concrete	Concrete (Upto 3000 psi) *	Stones	Lean Concrete	Concrete (3000 psi) *	Base / Sub Base	Asphalt Layer	Sub Base / Soling	Asphalt Layer
Malal Bagla Sandstone Quarry	BG1	✓	✓	✓	✓	✓	x	✓	✓	✓	✓	✓	x	x	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	x	✓	x	✓	x
Neem Danah Sandstone Quarry	BG2	✓	✓	✓	✓	✓	x	✓	✓	✓	✓	✓	x	x	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	x	✓	x	✓	x
Chaman Kot Sandstone Quarry	BG3	✓	✓	✓	✓	✓	x	✓	✓	✓	✓	✓	x	x	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	x	✓	x	✓	x
Bees Baghla Sandstone Quarry	BG4	✓	✓	✓	✓	✓	x	✓	✓	✓	✓	✓	x	x	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	x	✓	x	✓	x
Ghaziabad Sandstone Quarry	BG5	✓	✓	✓	✓	✓	x	✓	✓	✓	✓	✓	x	x	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	x	✓	x	✓	x
Shujabad Sandstone Quarry	BG6	✓	✓	✓	✓	✓	x	✓	✓	✓	✓	✓	x	x	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	x	✓	x	✓	x
Patriata Sandstone Quarry	BG7	✓	✓	✓	✓	✓	x	✓	✓	✓	✓	✓	x	x	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	x	✓	x	✓	x
Bhont Chowk Sandstone Quarry	BG8	✓	✓	✓	✓	✓	x	✓	✓	✓	✓	✓	x	x	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	x	✓	x	✓	x
Dhuli Sandstone Quarry	BG9	✓	✓	✓	✓	✓	x	✓	✓	✓	✓	✓	x	x	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	x	✓	x	✓	x
Lasdana Sandstone Quarry	BG10	✓	✓	✓	✓	✓	x	✓	✓	✓	✓	✓	x	x	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	x	✓	x	✓	x
Arja - Mahl River Gravel	BG11	✓	✓	✓	✓	✓	x	x	✓	✓	✓	✓	x	x	x	✓	✓	✓	✓	✓	✓	✓	✓	x	✓	✓	x	✓	x	x
Rafiqabad - Mahl River Gravel	BG12	✓	✓	✓	✓	✓	x	x	✓	✓	✓	✓	x	x	x	✓	✓	✓	✓	✓	✓	✓	✓	x	✓	✓	x	✓	x	x
Hari Ghel - Mahl River Gravel	BG13	✓	✓	✓	✓	✓	x	x	✓	✓	✓	✓	x	x	x	✓	✓	✓	✓	✓	✓	✓	✓	x	✓	✓	x	✓	x	x
Qadirabad - Mahl River Gravel	BG14	✓	✓	✓	✓	✓	x	x	✓	✓	✓	✓	x	x	x	✓	✓	✓	✓	✓	✓	✓	✓	x	✓	✓	x	✓	x	x
Dhal Qazian - Malwani Kas Gravel	BG15	✓	✓	✓	✓	✓	x	x	✓	✓	✓	✓	x	x	x	✓	✓	✓	✓	✓	✓	✓	✓	x	✓	✓	x	✓	x	x
Suitable ✓		Project Specific Studies including Mix Design ▲												Not Suitable x						Requires Mix Design in Recommended Case *										
The recommendations are based on the presumption that the available cement type in the State is Ordinary Portland Cement.																														

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NOTES:

1. Material suitability of very high strength and pre-stressed concrete shall be established on the basis of actual concrete mix design for any specific project.
2. The sources (BG 1~17) are reactive in terms of ASR. The recommended usage in concrete requires that total alkalis from all sources do not increase the threshold value of 2.5 kg per cubic meter of concrete.
3. The ASR susceptible sources can be used for normal concrete production with following options:
 - i). Using Low Alkali Cement (Alkalis as $\text{Na}_2\text{O} < 0.4\%$)
 - ii). Using Slag Blended Cement or Pozzolanic Cement
 - iii). Using Slag, Fly Ash or Silica Fume as Partial Replacement with the OPC
4. The gravel sources meet the requirement of base course. However, the usage as Aggregate Base Course will require to meet the specifications of crushed and rounded faces. This will be achieved through proper crushing technique. Aggregate Base Course should meet the requirement of more than 90% two faced crushed aggregate.
5. The usage of stone dust from sandstone/sandy gravel source should be avoided for the road construction.
6. The local limited exposures of Murree Formations if encounter during road cutting and project excavation and having properties similar to the identified sandstone sources, the above recommendations shall also prevail for this material.

for quarrying and borrowing from these sources are given in respective "Source Digest". Considering the difficult topographic conditions of the area for transport the material downhill, construction of chutes/conveyor belt system is recommended for quarry development.

7.9 Quantitative Estimate of Material Availability

The sources declared suitable have varying quantities of quarry-able material that are mentioned in the respective source digests and **Table 7.2**. A quick appraisal of the available sources and their recommended uses had brought forward following major inferences:

Bagh, Dhir kot and Harigel Tehsils

- 1 These tehsils are self-sufficient in (a) coarse aggregate required for low-strength concrete works, and (b) base/sub-base course of road and (c) stone for masonry.
- 2 These tehsils do not have any suitable source for (a) coarse aggregate required for high-strength concrete, (b) fine aggregate for low and high strength concrete, (c) base/sub-base material for inter-district level roads, and (d) coarse aggregate for asphalt works.

The above inferences are made in broader terms and can be used for developing material procurement plan for district Bagh.

CONSTRUCTION MATERIAL SOURCES IN AND AROUND AZAD JAMMU & KASHMIR				
Table 7.2				
Proposed Quarrying Method and Estimated Quarryable Material Quantities in Districts Bagh				
Source Designation and Title		Quarrying Method		Estimated Quarryable Quantity (10 ⁶ x m ³)
		Existing	Proposed	
BG-1	Malal Bagla Sandstone	No Quarry Activity	Existing to be continued and chute design is recommended	6.0
BG-2	Neem Dana Sandstone	No Quarry Activity	Existing to be continued and chute design is recommended	8.0
BG-3	Chamman Kot Sandstone	No Quarry Activity	Existing to be continued and chute design is recommended	12.0
BG-4	Bees Bagla Sandstone	No Quarry Activity	Conventional and chute design is recommended	12.0
BG-5	Ghaziabad Sandstone	No Quarry Activity	Conventional and chute design is recommended	4.0
BG-6	Shujabad Sandstone	No Quarry Activity	Conventional and chute design is recommended	10.0
BG-7	Patriata Sandstone	No Quarry Activity	Conventional and chute design is recommended	3.0
BG-8	Bhont Chowk Sandstone	No Quarry Activity	Conventional and chute design is recommended	6.0
BG-9	Dhuli Sandstone	No Quarry Activity	Conventional and chute design is recommended	6.0
BG-10	Lasdana Sandstone	No Quarry Activity	Conventional and chute design is recommended	20.0

CHAPTER 8

CONSTRUCTION MATERIAL SOURCES STUDY OF DISTRICT HAVELI

8.1 General

District Haveli were also included in the Pilot Phase of the study and investigations were conducted concurrently with the districts Muzaffarabad, Bagh and Jhelum Valley sharing the similar investigation approach and activities.

This chapter provides details of explorations, evaluations, and suitability assessments of all source's studies in district Haveli. The adequacy of construction material on district level is also discussed which serves as a realistic basis for preparing material procurement would plan for both the districts.

8.2 Administrative Setup and Physiography

District Haveli extends over an area of 598 square kilometers, which hosts a population of about 152,124 persons (2017 Census). It shares inter-district boundaries with Bagh District in the west, while in the East, North and South is bordered by "Line of Control" with India.

District Haveli comprises two tehsils including Haveli and Forward Kahuta. The main towns of the district include Mehmood Gali, Palangi and Khurshidabad. All these towns are connected through metaled roads. However, the main access to this district relies upon the weather as Lassdana and Haji Pir pass are snow covered in winters.

The district form part of Lesser Himalayan Zone, and their topography is mainly mountainous with valleys in between. The elevation ranges from 520 meters to 3800 meters. Pir Panjal is the main range having the famous Haji Pir Pass with elevation 3421 m. Moderate to high angle slopes and steep escarpments are prominent features of the area. The mountain slopes are mostly covered with coniferous forests. Haveli district drains into Poonch river through Betar and Palangi nullah.

The climate within the districts varies greatly with altitude. The snowline in winters and summers times is at elevations 1200 m and 3300 m respectively. The eastern part of the districts is very cold in winters and moderate in summers, while the deeper part of Haveli remains cold in winters and hot in summers. May, June and July are the hottest months, while December, January and February are the coldest months. The maximum and minimum temperature in the month of January varies between 30°C and 16°C, while the same in the month of June vary between 40°C and 22°C respectively. The annual precipitation rate is about 1500 millimeters.

Muzaffarabad city is located at a distance of about 150 km and 130 km from Forward Kahuta city via Kohala and Suddhen Gali route respectively. Islamabad is located at a distance of 216 and 228 km from Bagh city via Kohala and Rawalakot route respectively.

Fig. 8.1 shows the administrative and physiographic details of district Haveli.

8.3 Geology

District Haveli; situated in the western axial zone of Hazara-Kashmir syntaxis, comprises part of the Lesser Himalayas. The syntaxis exhibits two major thrusts, including Panjal Thrust (PT) and Main Boundary Thrust (MBT) in the north and south respectively.

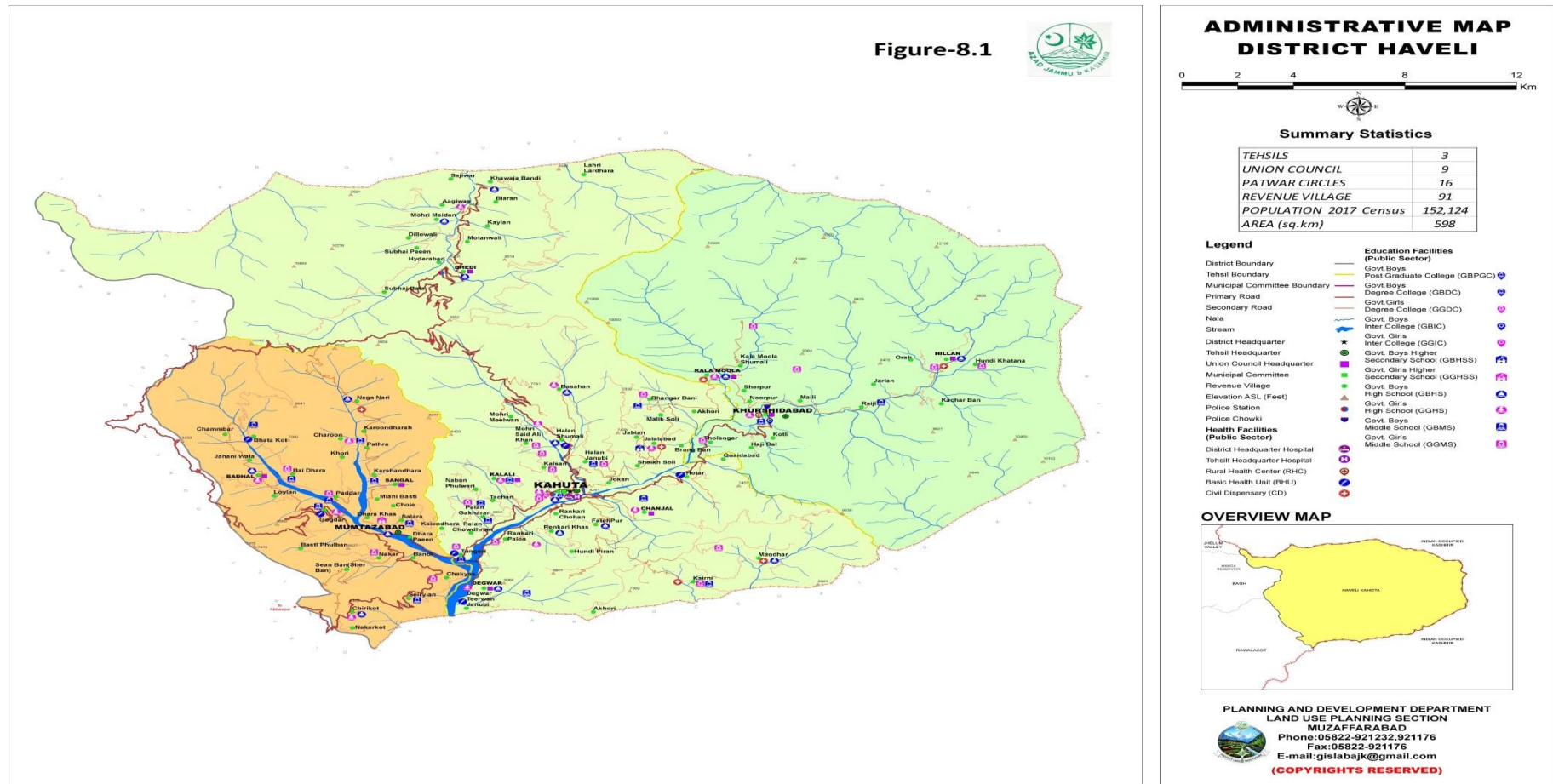


Figure 8.1: Administrative and Physiographic Details of District Haveli

These thrusts have developed three distinct geologic domains within the study area with respect to their relative position within the syntaxis and geologic formations. These domains include (a) the area north of Panjal Thrust comprising older metamorphic rocks, (b) the area between Panjal and MBT comprising volcanics and meta-sediments, and (c) the area south of MBT mostly comprising molassic rocks. The molassic rocks comprise siltstone; sandstone and shale of early Miocene age, are mostly exposed in Lassdana, Palangi and Forward Kahuta areas. The volcanics and meta-sediments along with Eocene rocks are exposed in eastern part of Haveli district.

In addition to the above, the areas forming major valley floors which are mostly covered with thick terrace deposits comprising gravel and boulders embedded in clayey silt matrix. The hill slopes at places are covered with colluvium of varying thicknesses. A simplified geological map is presented as **Fig. 8.2**.

8.4 Construction Material Prospecting

The geologic formations exposed within district were carefully evaluated for their potential with respect to procurement of material for construction of buildings, bridges and roads. For this purpose, the geologic formations were categorized with respect to the broad engineering characteristics of various rock types. A map showing construction material prospects within the districts was prepared on the basis of this categorization, which is presented in **Fig. 8.3**. A summary of the inferences derived from this simplified map is presented below:

- The geologic formations exposed in 12% of the area have no prospect for concrete and asphalt aggregate as well as other major construction material required. These formations include Patala, Salkhala and Panjal.
- Murree and Kamlial Formations cover almost 58% of the total district area. These formations comprise alternating beds of siltstone, shale and sandstone. The siltstone and shale beds form more than two third of the geologic formation, however, they have no prospect usage as construction material. On the other hand, the sandstone beds are recognized as having marginal potential depending upon the hardness and joint frequency of the individual beds.
- Geologic formations; having relatively higher prospect for serving as construction material sources; occupy only 5% area of the entire district. These formations include Margalla Limestone and Panjal Volcanics.
- Nearly 2% of the area is covered with Quaternary deposits comprising mainly flood plain and terrace deposits, etc. Amongst these, only flood plain deposits have prospects for construction material depending upon the rocks exposed in the stream catchments.

8.5 Exploration of Construction Material Sources

A comprehensive exploration program for identifying material suitable for use in construction of buildings, roads and bridges was executed in the district. The program was based on the local physiographic conditions, assessment of geology and material prospecting, existing sources, relevant deficiencies and State needs. The program activities included systematic identification of sources, preliminary field demarcations and assessments, comprehensive sampling, qualitative and quantitative assessments and rapid environmental examination. These activities were conducted in accordance with the

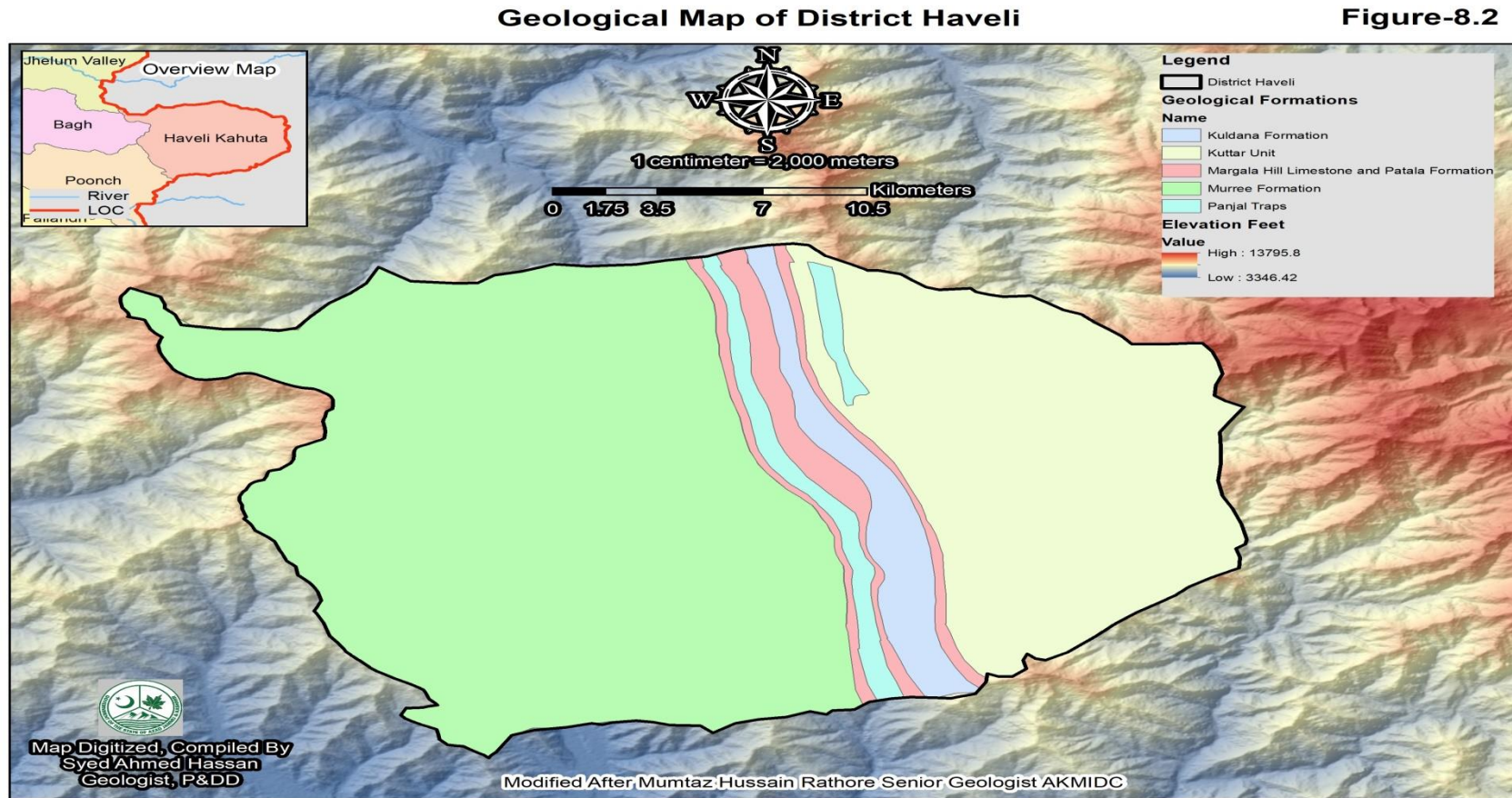


Figure 8.2: Geological Map of District Haveli

%age area Distribution w.r.t. Constructiton Material Propsect in District Haveli

Figure-8.3

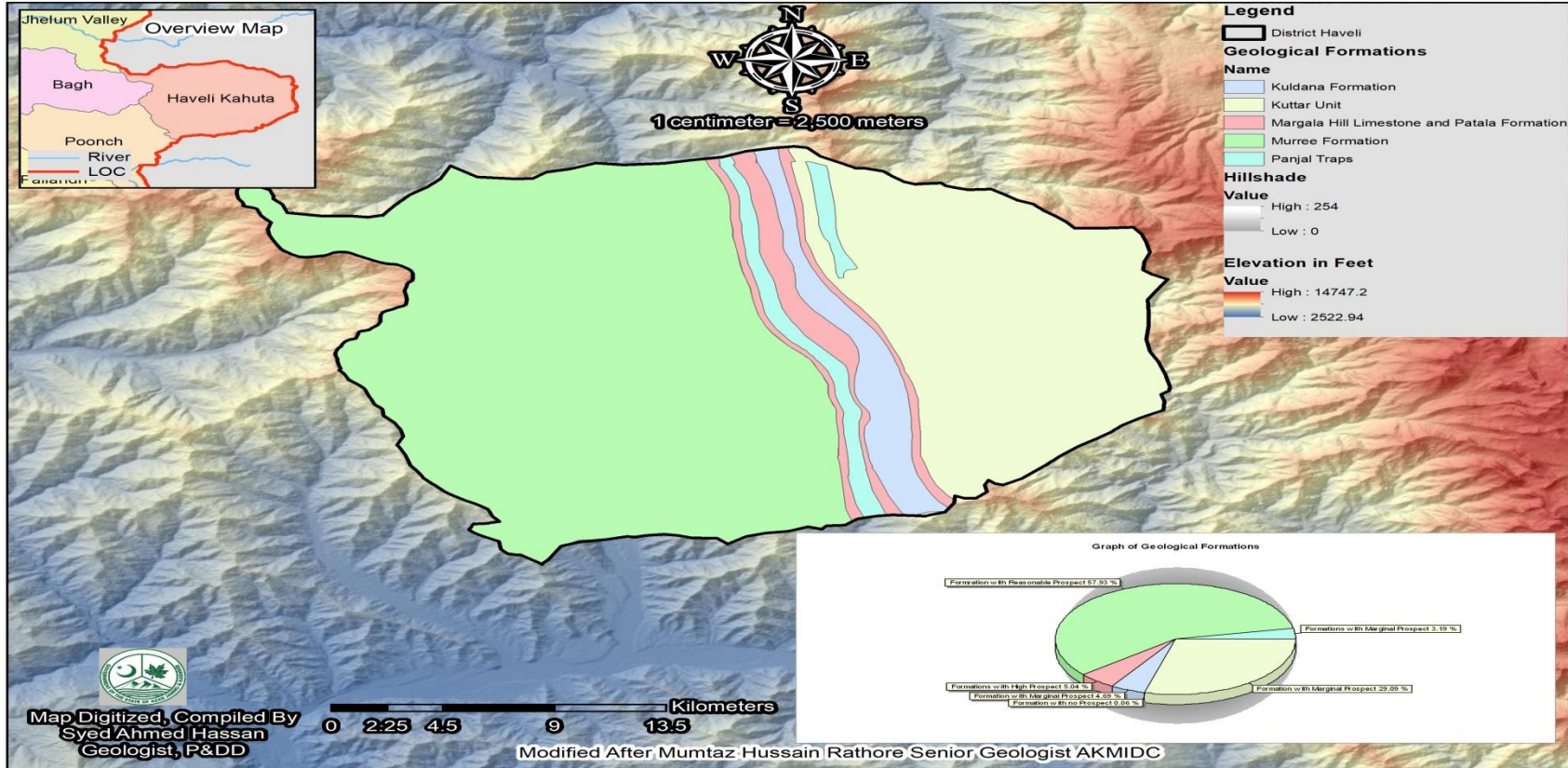


Figure 8.3: Construction Material Prospects of District Haveli

criteria and methodology stated in the previous sections. A summary of the exploration program is given below:

- 1 5 sources were identified and studied within in district. All sources were evaluated as potential sources for coarse aggregate, base/sub-base material, and stones, while the rest were evaluated as potential sources for fine aggregate. Locations of all these sources are shown in **Fig. 8.4**.
- 2 Rapid environmental examination of all the sources was conducted in the very beginning of the exploration. Moreover, a comprehensive review of the existing quarrying techniques and material procurement procedures was carried out.
- 3 Hand samples were collected from these sources, out of which representative samples were analyzed through petrographic microscope after preparing thin sections. Set of petrographic analysis results for each source was evaluated with respect to perspective usages of the material.
- 4 Bulk samples collected from these sources were analyzed for physical properties at the Central material Testing Laboratory, WAPDA and Road Research Institute, C&W Department, Government of Punjab. The testing program was prepared considering the expected uses of the material and laboratory test results were accordingly evaluated.
- 5 In addition to natural rock outcrops for production of aggregate and stones, the Panjal Formation also hosts Pozzolanitic Ash beds. A study carried out by AKMIDC to evaluate these beds is appended as appendix-1 to this report.

8.6 Source Digests

Detailed information pertinent to any individual source is put together in the form of "Source Digest". The information for each source relates to (a) location and accessibility, (b) physiographic and geologic conditions, (c) environmental appraisal, (d) extent of investigations conducted, (e) summary results of investigations, (f) principal evaluations, and (g) recommendations. The source digests are organized alpha-numerically for efficient tracking of information.

The information provided in the respective source digests form basis for the analyses and procurement plans.

Digests of nineteen (8) sources; as identified and studied within district, are being provided separately.

8.7 Suitability of the Investigated Sources

A careful evaluation of the 8 investigated sources was conducted to establish their suitability in broad terms as construction material. The evaluation was made in strict compliance to the criteria stated in Chapter 4. A summary of the evaluation results is given below:

- 1 Only two (02) rock sources have been rated as suitable for quarrying coarse aggregate for producing (a) concrete of varying strength, (b) asphalt road works, and (c) base/sub-base road elements. They are located in Khurshidabad, Haveli tehsil and comprise limestone and dolerite rock.
- 2 One (01) riverbed gravel source have been rated as suitable for borrowing coarse aggregate for producing (a) concrete of low-strength (b) base/ sub-base road elements.

Sample Location Map, District Haveli

Figure 8.4

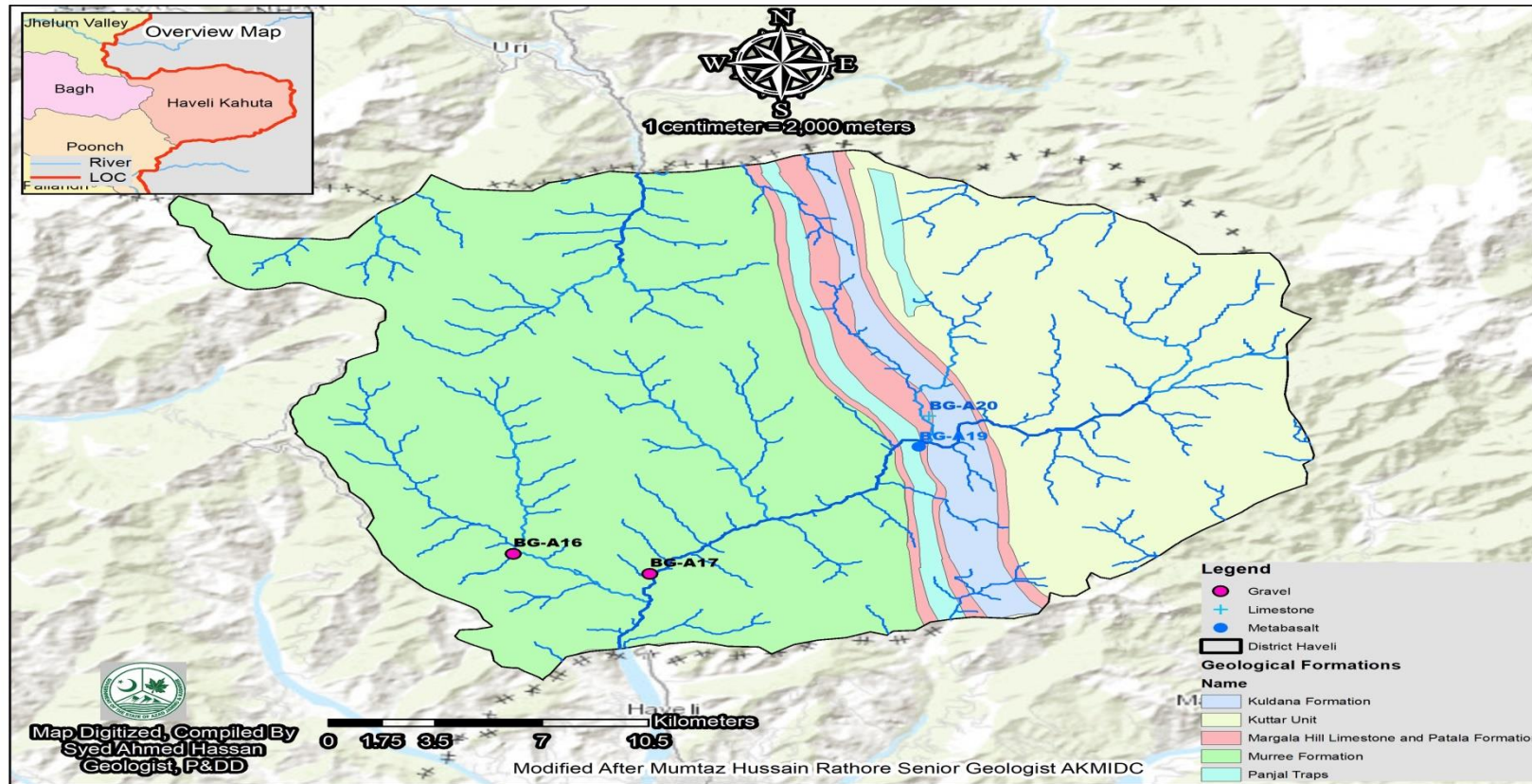


Figure 8.4: Sample Location Map of District Haveli

- 3 These sources are located within the beds of Palangai nullah near Betar. The gravel and boulders of these sources mostly comprise of sandstone.
- 4 The local limited exposures of Murree Formation having characteristics similar to the identified sources, the recommendations presented in Table 8.1 for this material shall also prevail. Such material may encounter during road cutting and project excavations

In addition to natural rock outcrops for production of aggregate and stones, the Panjal Formation also hosts Pozzolanic Ash beds. A study carried out by AKMIDC to evaluate these beds is appended as appendix-1 to this report

Detailed comments concerning the suitability of each explored sources is made in the respective "Source Digest".

8.8 Recommended Uses of Suitable Sources

The sources declared suitable have varying petrographic, physical and engineering characteristics. A cautious evaluation of the characteristics of each source was carried out to identify its appropriate uses as construction material in light of the Composite Schedule of Rates for AJ&K.

Based on this evaluation, the recommended uses of all the sources for various construction types are indicated in **Table 8.1**. Necessary precautions for quarrying and borrowing from these sources are given in respective "Source Digest". Considering the difficult topographic conditions of the area for transport the material downhill, construction of chutes/conveyor belt system is recommended for quarry development.

8.9 Quantitative Estimate of Material Availability

The sources declared suitable have varying quantities of quarry-able material that are mentioned in the respective source digests and **Table 8.2**. A quick appraisal of the available sources and their recommended uses had brought forward following major inferences:

- 1 This district is in surplus of the material including (a) coarse aggregate for all types of concrete and asphalt works, (b) base/sub-base for road works, and (c) masonry stone.
- 2 This district has no source of fine aggregate.

The above inferences are made in broader terms and can be used for developing material procurement plan for district Haveli.

CONSTRUCTION MATERIAL SOURCES IN AND AROUND AZAD JAMMU & KASHMIR

TABLE 8.1

Recommended Uses of Various Material Sources in District Haveli

QUARRY NAME	Source Code	TYPE OF CONSTRUCTION																														
		STRUCTURES WITH GREATER LIFE RISK										STRUCTURES WITH LESS LIFE RISK						ROADS														
		Private Houses and Public Buildings (Schools, BHU, etc. maximum of two storeys)					Major Public Buildings (Colleges, Hospitals and Bridges etc.)					Causeways		Culverts		Concrete		Masonry walls		Inter-district Roads		Intra-district Roads		Community Roads								
		Stone	Non-Load Bearing Concrete Blocks	Load Bearing Concrete Blocks (2000 Psi)	Lean Concrete	Concrete upto 2000 psi	Concrete 2000-4000 psi *	Stones	Non-Load Bearing Concrete Blocks	Load Bearing Concrete Blocks	Lean Concrete	Concrete upto 2000 psi	Concrete 2000-4000 psi *	High Strength Concrete	Pre-stressed Concrete	Stone	Lean Concrete	Concrete (Upto 3000 psi) *	Stone	Lean Concrete	Reinforced Concrete (3000psi) *	Lean Concrete	Concrete (Upto 3000 psi) *	Stones	Lean Concrete	Concrete (3000 psi) *	Base / Sub Base	Asphalt Layer	Sub Base / Soling	Asphalt Layer	Soling	Asphalt Layer
Palangi Nullah Gravel	BG16	✓	✓	✓	✓	✓	x	x	✓	✓	✓	✓	x	x	x	✓	✓	✓	✓	✓	✓	✓	x	✓	✓	✓	x	✓	✓	✓	✓	x
Tangari - Betar River Gravel	BG17	✓	✓	✓	✓	✓	x	x	✓	✓	✓	✓	x	x	x	✓	✓	✓	✓	✓	✓	✓	x	✓	✓	✓	x	✓	✓	✓	✓	x
Khurshidabad Limestone Quarry	BG18	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	▲	▲	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Khurshidabad Dolerite Quarry	BG19	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	▲	▲	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Suitable ✓		Project Specific Studies including Mix Design ▲										Not Suitable x						Requires Mix Design in Recommended Case *														
The recommendations are based on the presumption that the available cement type in the State is Ordinary Portland Cement.																																

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NOTES:

1. Material suitability of very high strength and pre-stressed concrete shall be established on the basis of actual concrete mix design for any specific project.
2. The sources (BG 1~17) are reactive in terms of ASR. The recommended usage in concrete requires that total alkalis from all sources do not increase the threshold value of 2.5 kg per cubic meter of concrete.
3. The ASR susceptible sources can be used for normal concrete production with following options:
 - i). Using Low Alkali Cement (Alkalis as Na₂O < 0.4%)
 - ii). Using Slag Blended Cement or Pozzolanic Cement
 - iii). Using Slag, Fly Ash or Silica Fume as Partial Replacement with the OPC
4. The gravel sources meet the requirement of base course. However, the usage as Aggregate Base Course will require to meet the specifications of crushed and rounded faces. This will be achieved through proper crushing technique. Aggregate Base Course should meet the requirement of more than 90% two faced crushed aggregate.
5. The usage of stone dust from sandstone/sandy gravel source should be avoided for the road construction.
6. The local limited exposures of Murree Formations if encounter during road cutting and project excavation and having properties similar to the identified sandstone sources, the above recommendations shall also prevail for this material.

CONSTRUCTION MATERIAL SOURCES IN AND AROUND AZAD JAMMU & KASHMIR

Table 8.2

Proposed Quarrying Method and Estimated Quarryable Material Quantities in District Haveli

Source Designation and Title	Quarrying Method		Estimated Quarryable Quantity (10 ⁶ x m ³)
	Existing	Proposed	
BG-18 Khurshidabad Limestone	No Quarry Activity	Conventional and chute design is recommended	15.0
BG-19 Khurshidabad Dolerite	No Quarry Activity	Conventional and chute design is recommended	4.0

CHAPTER 9

CONSTRUCTION MATERIAL SOURCES STUDY OF DISTRICT KOTLI

9.1 General

Upon completion of the Pilot Phase of the project, the study was extended in the remaining six districts. Kotli, Mirpur and Bhimber were grouped in Stage – I of the Main Study and were designated as southern districts study.

The experiences gained during the Pilot Phase and the approach revisited after the outcome of pilot stage was successfully applied during this main study. Like the Pilot Phase, the study included assessment of area potential, identification of all existing and potential sources, qualitative/ quantitative evaluation, and accordingly determining their suitability for use as construction material for buildings, roads and bridges.

This chapter provides details of explorations, evaluations, and suitability assessments of all source's studies in district Kotli. The adequacy of construction material on district level is also discussed which serves as a realistic basis for preparing material procurement would plan for the district.

9.2 Administrative Setup and Physiography

District Kotli extends over an area of 1862 km² (964 square mile), which hosts a population of about 563,094 persons (1998 Census- 1999 Projection). It shares inter-district boundaries with Mirpur, Bhimber and Poonch districts in the south and north respectively. In the west, it is bounded by the Punjab (Pakistan), while in the east is bordered by "Line of Control" with India.

The district comprises four tehsils, including Kotli, Nikial, Khoi Ratta and Sensa. Kotli city is the districts headquarter. The other tehsil headquarters are Nikial, Khoi Rata and Sensa. The other main towns include Tatta Pani, Kamroti, and Gulpur.

The district forms part of Lesser Himalayan Zone, and its topography is mainly mountainous with valleys in between. The elevation ranges between 351 meters and 1493 meters. High angle slopes and steep escarpments are prominent features of the area.

The entire district; is drained by Poonch river and its two tributaries Nail and Bun nullah. Nail joins Poonch at the upstream of Kotli City while Bun nullah joins Poonch river at downstream of Kotli City.

The climate within the district varies greatly with altitude. The northern part is very cold in winters and moderate in summers, while the southern remains cold in winter and hot in summer. May, June and July are the hottest months, while December, January and February are the coldest months.

Kotli, the district headquarter, is 160 km from Rawalpindi via Kahuta, Rawalakot.

Fig. 9.1 shows the administrative and physiographic details of district Kotli.

9.3 Geology

District Kotli is situated in the southern extremity of the Hazara-Kashmir syntaxis comprises part of the Lesser Himalayas. The geology of the district is divided into three main tectono- stratigraphic units:

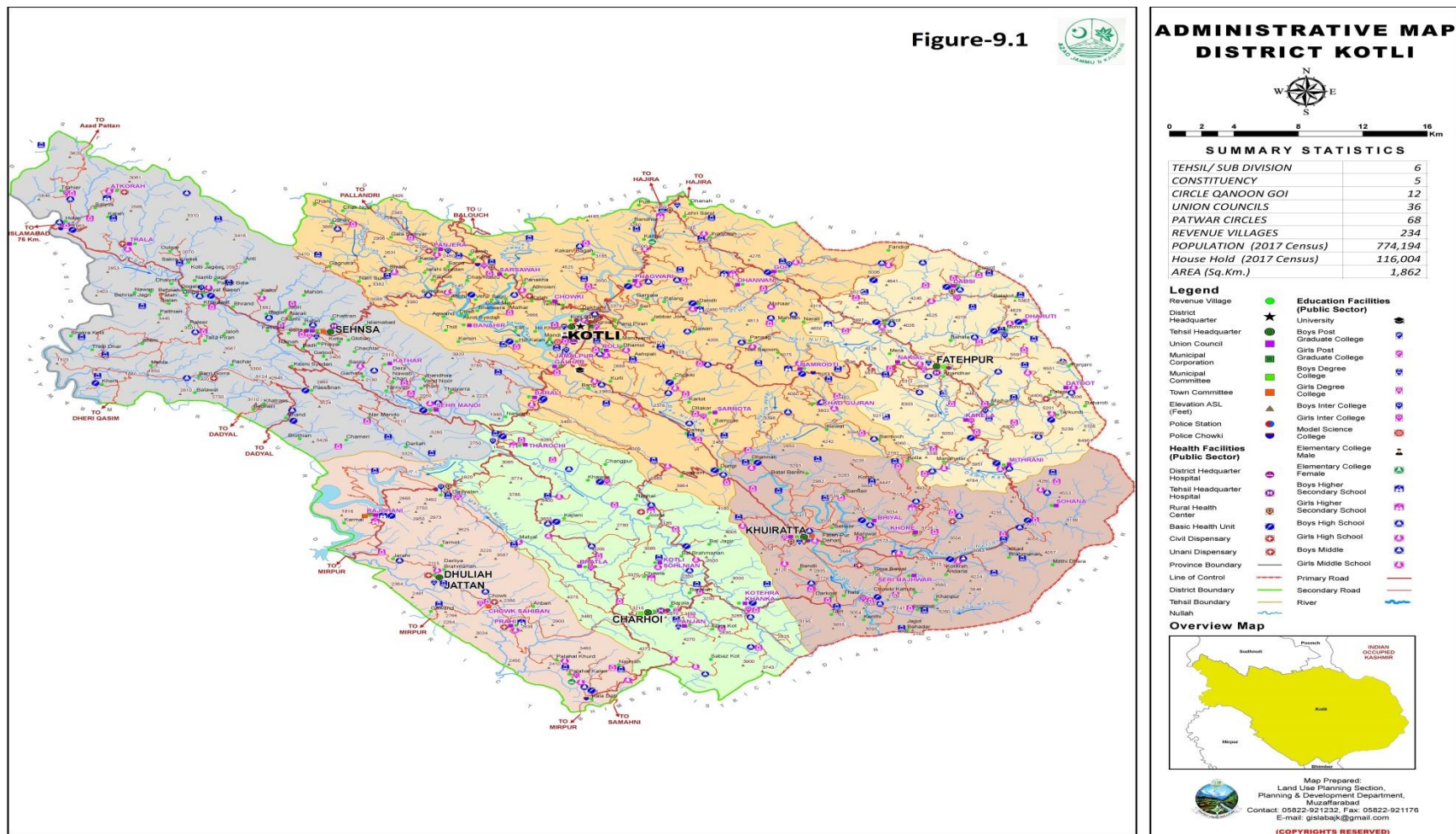


Figure 9.1: Administrative and Physiographic Details of District Kotli

1. The Tata-Pani – Kotli and Khui Ratta Anticlines
2. Miocene Sequence (Murree Formation)
3. Siwalik Group

In district Kotli, the hard rock outcrops are essentially in the form of an elliptical dome. This elliptical dome is a plunging anticline extends in NW-SE direction having a longitudinal stretch of about 29 km with a maximum width of 4 km near Shistetar. The northern extremity of this anticline is near Nikial and the southern extremity is near Tata-Pani. The anticline is the predominant feature of the district's geology. This anticline comprises Precambrian Abbottabad Formation. The formation of the anticline occurred during the Alpine-Himalayan mountain system. The upheaval provided the environment to deposition of molassic deposits.

The anticline, therefore on both the flanks has unconformable contact with the Murree Formation, which is the monotonous series of siltstone/ shale and sandstone. This unit however has the faulted contact with the Precambrian rocks of the anticlinal structure near Kamroti.

The termination of Murree period in the middle Miocene coincided with another episode of mountain building on the northern boundaries of the subcontinent. A long narrow depression formed in front of the raising mountains called foredeep was the site of deposition of the third unit of the area "Siwalik group" which has been up-thrusted the Miocene Murree Formation. This low angle thrust is called as Himalayan Frontal Thrust (HFT). The Siwalik Group rocks are generally weak and friable sandstone, siltstone and claystone.

In addition to the above, the areas forming major valley floors, which are mostly covered with thick terrace deposits comprising gravel and boulders embedded in clayey silt matrix. A simplified geological map is presented as **Fig.9.2**.

9.4 Construction Material Prospecting

The geologic formations exposed within the district were carefully evaluated for their potential with respect to procurement of material for construction of buildings, bridges and roads. For this purpose, the geologic formations were categorized with respect to the broad engineering characteristics of various rock types presented as **Fig. 9.4**.

A summary of the inferences derived from the available geological maps and site confirmation of the map is presented as below:

- The Siwalik Group exposed in the area has no prospect for concrete and asphalt aggregate as well as other major construction material.
- Murree Formation is also exposed in the district. This formation comprises alternating beds of siltstone, shale and sandstone. The siltstone and shale beds form more than two third of the geologic formation, however, they have no prospect usage as construction material. On the other hand, the sandstone beds are recognized as having marginal prospect depending upon the hardness and joint frequency of the individual beds.
- Geologic formations; having relatively higher potential for serving construction material; occupy only 10% area of the entire district. These rocks belong to the formation exposed in the Tata-Pani – Kotli and Khui Ratta anticlines (dome). Very limited exposures of Margalla Limestone having a transitional upper contact with

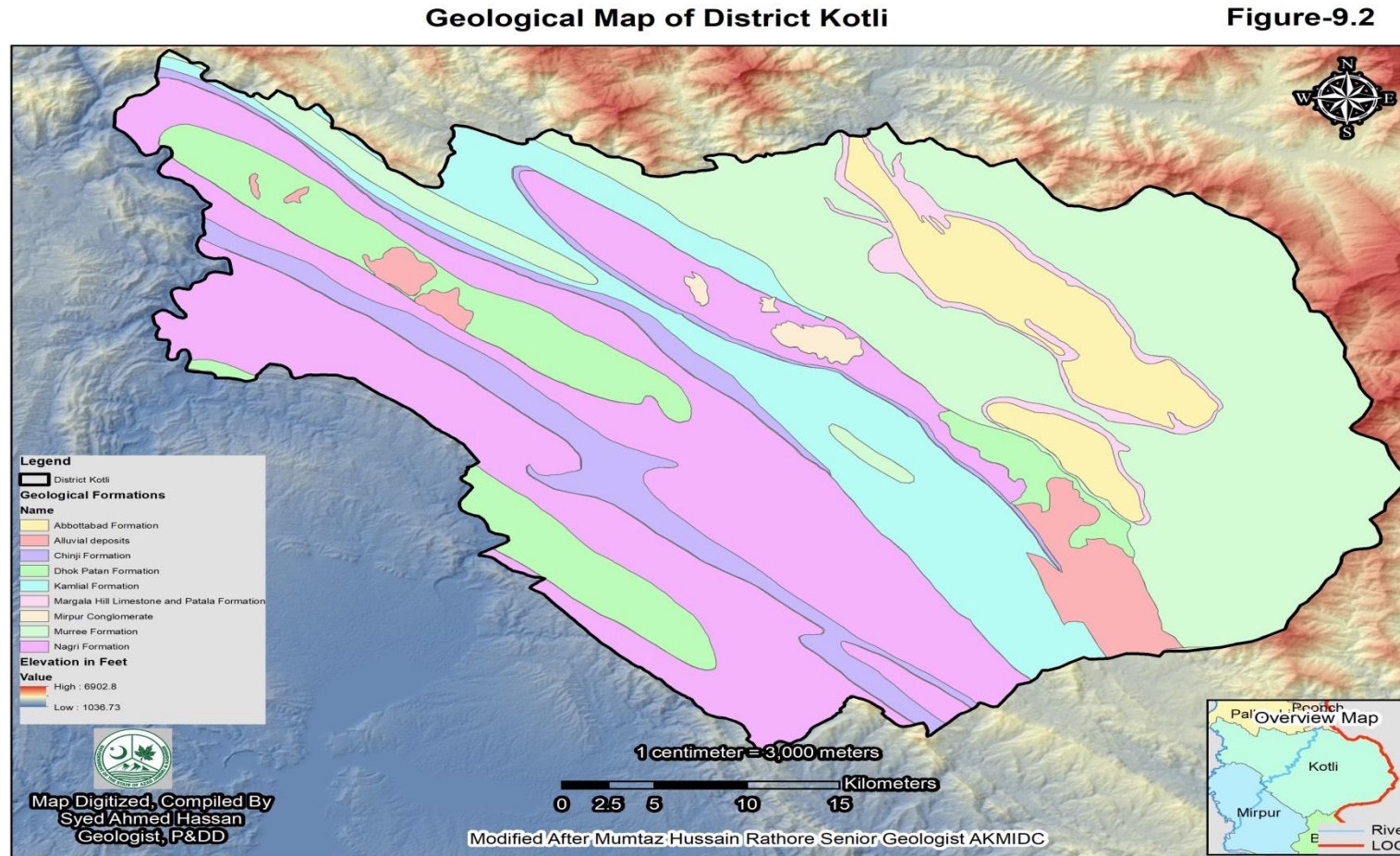


Figure 9.2: Geological Map of District Kotli

Sample Location Map of District Kotli

Figure-9.3

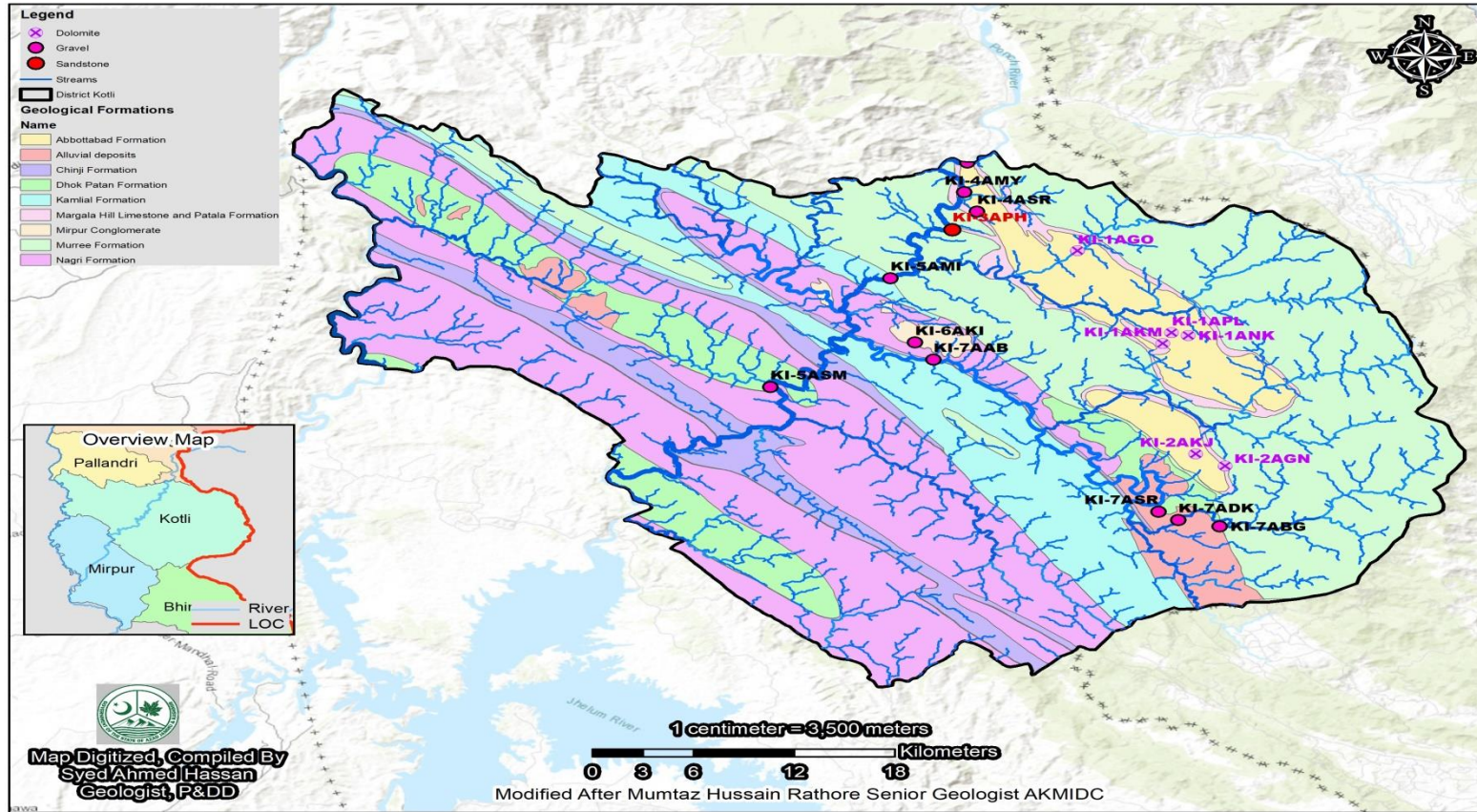


Figure 9.3: Sample Location Map of District Kotli

%age area distribution of Geological Formations w.r.t Construction Material Prospect District Kotli

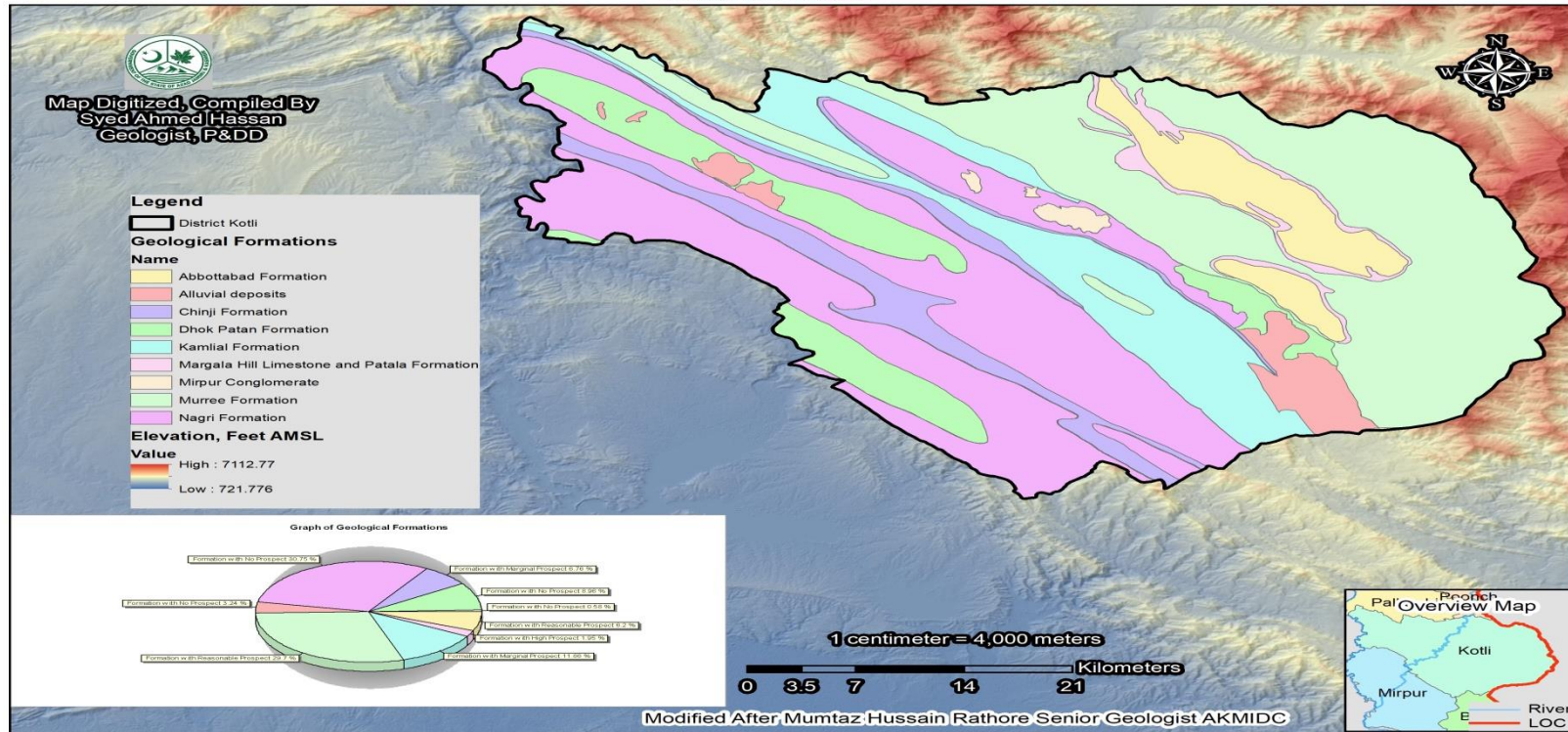


Figure 9.4

Figure 9.4: Construction Material Prospects of District Kotli

- Murree Formation are exposed. The formation has interbedded shale which contains pyrite. The inter-bedded shale requires selective quarrying and the presence of pyrite in the thinly bedded limestone make this source having no prospect for aggregate exploitation.
- The Quaternary deposits comprising mainly flood plain and terrace deposits of Poonch river and its tributaries has potential for aggregate production depending upon the rocks exposed in the stream catchments.

9.5 Exploration for Construction Material Sources

A comprehensive exploration program for identifying material suitable for use in construction of buildings, roads and bridges was executed in the entire district. The program was based on the local physiographic conditions, assessment of geology and material prospecting, existing sources, relevant deficiencies and State needs. The program activities included systematic identification of sources, preliminary field demarcations and assessments, comprehensive sampling, qualitative and quantitative assessments and rapid environmental examination.

These activities were conducted in accordance with the criteria and methodology stated in the previous sections. Thirty-one (31) sources of coarse aggregate have been identified in the district. Out of these 10 sources are located in the Siwalik rocks, which have no potential of aggregate sources, therefore these sources were discarded in the very early stage of the investigation. Location map of these sources is shown as **Fig. 9.3**.

A summary of the exploration program for the sources is given below:

9.5.1 Tatta-Pani Kotli Anticline Dolomite Source

Tatta Pani- Kotli Anticline is an important geological feature of the southern Kashmir in district Kotli. The anticline is underlain by the Hazara Slates. Approximately 95% of the exposed rock consists of dolomite and 5% limestone. The limestone exposed on the flanks of anticline is Margalla Limestone. The limestone exposed in the Nikial and Kotli area at few places is micritic, fossiliferous and pyritic wackestone to packstone nodular limestone of grey to black color.

The rocks associated with anticline have potential for aggregate production. Few crushers have already been installed around the anticline rim on Goi Dandani and Kotli Nikial Road.

Samples have been collected from the following locations:

- Kamroti Dolomite (existing)
- Peer Lasora Ankeritic Dolomite (potential)
- Nikial Dolomite (potential)
- Goi – Dandini Dolomite (existing)
- Tatta-Pani – Sawar Dolomite (potential)

9.5.2 Khui Ratta (Kerjai) Anticline

Khui Ratta anticline is located in the south of the Tatta-Pani Kotli Anticline. This anticline is shorter in extent as compare to Tatta-Pani Kotli anticline. Khui Ratta is double plunging anticline. Both these anticlines are separated by a local fault. The stratigraphic

setup of this anticline is same as that of the northern anticline. Samples have been collected from following potential locations:

- Gaian Quartzite Source, Khoi Ratta
- Kerjai Dolomite Source, Khoi Ratta

9.5.3 Poonch Riverbed and Tributaries Gravel

The entire district; is drained by Poonch river and its tributaries. Two main tributaries are Nail and Bun. Nail joins Poonch river at the upstream of Kotli City while Bun nullah joins Poonch river at downstream of Kotli City. The riverbed deposits of Poonch river and its tributaries have huge potential for extraction of sandy gravel. A number of crushers have been installed at different locations. The finished product of these crushers is a mixture of naturally occurring gavel as well as the crushed stones of over sizes.

Samples from each existing location of this source have been collected.

- Mandi-Poonch River Gravel, Kotli
- Sawar-Poonch River Gravel, Kotli
- Mehtry-Poonch River Gravel, Tata-Pani
- Tata-Pani-Poonch River Gravel, Tata-Pani
- Akberi Bridge/ Nullah Gravel, Moonila Kotli
- Dheri- Khorbun Nullah Gravel, Khoi Ratta
- Berot Gala Nullah Gravel, Khoi Ratta
- Sekhor-Bun Nullah Gravel, Khoi Ratta
- Ser Mandi Poonch River, Gravel Gulpur

9.5.4 Poonch River Older Terrace Deposits

Extensive older terraces of the Poonch river are about 147 m above the present river bed near Kurti, six (6) km from Kotli City is another area of investigation. These extensive gravel deposits are being extracted and crushed. Samples of crushed aggregate were collected.

9.5.5 Phagwari Sandstone Source

Murree Formation occupies a major part of the exposed bedrock in the district. This formation is composed of alternating series of shale and sandstone. The formation has been divided into lower and upper part. Sandstone of lower part is generally hard and tough. One such outcrop is located near the village Phagwari and has been sampled for further studies.

The upper part of the formation forming the western part of the formation in the district has no potential as this comprises maroon colored, soft sandstone.

9.5.6 Siwalik Group

The Siwalik Group comprises formations bearing friable sandstone, and clay stone are also distributed in the area. These formations have no value as aggregate. The sandstone is friable and the derived material, therefore, is fine silty sand.

9.6 Source Digests

Detailed information pertinent to an individual source is put together in the form of "Source Digest". The information for each source relates to (a) location and accessibility, (b) physiographic and geologic conditions, (c) environmental appraisal, (d) extent of investigations conducted, (e) summary results of investigations, (f) principal evaluations, and (g) recommendations. The source digests are organized alpha-numerically for efficient tracking of information.

The information provided in the respective source digests form basis for the analyses and procurement plans.

Digests of 21 sources; as identified and studied within the district, are being provided separately.

9.7 Suitability of the Investigated Sources

A careful evaluation of the 33 investigated sources was conducted to establish their suitability in broad terms as construction material. Twenty-one (21) sources have been selected for further study. Twelve (12) identified sources were disregarded in the very early stage of studies, as these sources belong to Murree Formation. The evaluation was made in strict compliance to the criteria stated in Chapter 4.

A summary of the evaluation results is given below:

- 1 Five (05) rock sources have been rated as suitable for quarrying coarse aggregate for producing (a) concrete of varying strength, (b) asphalt road works, and (c) base/ sub-base road elements. These sources belong to Tatta-Pani Kotli and Khui Ratta anticlines. The rocks comprising these sources include dolomite, and meta-sediments. These sources are also suitable for quarrying stone for masonry works.
- 2 One sandstone source has been rated as suitable for quarrying stone for various masonry works and soling material for road works. This source is located at Phagwari.
- 3 Thirteen (13) riverbed gravel sources have been rated as suitable for borrowing coarse aggregate for producing (a) concrete of low-strength (b) base/ sub-base road elements. These sources are located within the beds of (a) Poonch river at various localities in the district (b) Nail and Bun nullahs (c) Older terraces of the Poonch river. The gravel and boulders of these sources mostly comprise quartzite.

Detailed comments concerning about the suitability of each of the explored sources are made in the respective "Source Digest".

9.8 Recommended Uses of Suitable Sources

The sources declared suitable have varying petrographic, physical and engineering characteristics. A cautious evaluation of the characteristics of each source was carried out to identify its appropriate uses as construction material in light of the Composite Schedule of Rates for AJ&K.

Based on this evaluation, the recommended uses of all the sources for various construction types are indicated in Table 9.1. Necessary precautions for quarrying and borrowing from these sources are given in the respective "Source Digest".

CONSTRUCTION MATERIAL SOURCES IN AND AROUND AZAD JAMMU & KASHMIR

TABLE 9.1

Recommended Uses of Various Material Sources in District Kotli

QUARRY NAME	Source Code	TYPE OF CONSTRUCTION																															
		STRUCTURES WITH GREATER LIFE RISK										STRUCTURES WITH LESS LIFE RISK						ROADS															
		Private Houses and Public Buildings (Schools, BHU, etc. of max. 2 storeys)					Major Public Buildings (Colleges, Hospitals and Bridges etc.)					Causeways		Culverts		Concrete	Masonry walls	Inter-district Roads	Intra-district Roads	Community Roads													
		Stone	Non-Load Bearing Concrete Blocks	Load Bearing Concrete Blocks (2000 psi)	Lean Concrete	Concrete upto 2000 psi	Concrete 2000-4000 psi *	Stones	Non-Load Bearing Concrete Blocks	Load Bearing Concrete Blocks (2000 psi)	Lean Concrete	Concrete upto 2000 psi	Concrete 2000-4000 psi*	High Strength Concrete	Pre-stressed Concrete	Stone	Lean Concrete	Concrete (Upto 3000 psi)*	Stone	Lean Concrete	Reinforced Concrete (3000psi) *	Lean Concrete	Concrete (Upto 3000 psi)*	Stones	Lean Concrete	Concrete (3000 psi)	Base / Sub Base	Asphalt Layer	Sub Base / Soling	Asphalt Layer	Soling	Asphalt Layer	
Kotli-Nikial Anticline ^{(a) & (b)}	KI-1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	▲	▲	▲	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Khoi Rata Anticline (Kerjai) ^(b)	KI-2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	▲	▲	▲	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Murree Formation	KI-3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	x	x	x	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	x	✓	x	✓	x	x		
Poonch River Gravel-I	KI-4	x	✓	✓	✓	✓	x	x	✓	x	✓	x	x	x	x	✓	✓	x	✓	✓	✓	✓	✓	x	✓	✓	✓	x	✓	x	✓	x	
Poonch River Gravel-II	KI-5	x	✓	✓	✓	✓	x	x	✓	x	✓	x	x	x	x	✓	✓	x	✓	✓	✓	✓	✓	x	✓	✓	✓	x	✓	x	✓	x	
Poonch Terraces	KI-6	x	✓	✓	✓	✓	x	x	✓	x	✓	x	x	x	x	✓	✓	x	✓	✓	✓	✓	✓	✓	x	✓	✓	x	✓	x	x	x	
Khorban Nullah Gravel	KI-7	x	✓	✓	✓	✓	x	x	✓	x	✓	x	x	x	x	✓	✓	x	✓	✓	✓	✓	✓	x	✓	✓	✓	x	✓	x	✓	x	
Suitable ✓		Project Specific Studies including Mix Design ▲										Not Suitable x						Requires Mix Design in Recommended Case *															
The recommendations are based on the presumption that the available cement type in the State is Ordinary Portland Cement.																				CONTINUED ON NEXT PAGE													

CONSRUCTION MATERIAL SOURCES IN AND AROUND AZAD JAMMU & KASHMIR
TABLE 9.1

Recommended Uses of Various Material Sources in District Kotli

NOTES:

1. (a) The source indicated is suitable for all 2000-4000 concrete classes only if no mixing of chert is ensured. The quartzite in the quarry is reactive in terms of ASR. Generally, the source is suitable with exception of quartzite and ankeritic dolomite exposed in the source. Therefore for sensitive structures and high strength concrete project specific studies are recommended.
2. (b) The source rock contains invariably varied thick layers of cherty dolomite. Both constituents contaminate the aggregate derived from the source. The aggregate may or may not be ASR susceptible depending on the contamination percentage. In such circumstances it is recommended to use the aggregate in concrete when the total alkalis from all sources do not increase the threshold value of 2.5 kg per cubic meter for concrete.
3. Material suitability of very high strength and prestressed concrete shall be established on the basis of actual concrete mix design
4. The sources can be used for concrete with the following options if declared non recommended on the basis of ASR susceptibility, however this requires source specific study.
 - i). Low Alkali Cement (Alkalis as Na_2O less than 0.4%)
 - ii). Slag Cement or Pozzolanic Cement
 - iii). Using Slag, Fly Ash or Silica Fume as Partial Replacement with the OPC
5. The reactive aggregates are being recommended for few concrete classes keeping in view that the cement content in such concrete is quite low. The total alkalis in concrete will not increase the threshold level of 2.5kg/ cu.m.
6. Use boulders of river/ nullah bed (+10 inch) for soling stone, if required.
7. The local limited exposures of sandstone, limestone and dolomite if encountered during road cutting and project excavation and having properties similar to the identified sources, the above recommendations shall also prevail for this material.

CHAPTER 10

CONSTRUCTION MATERIAL SOURCES STUDY OF DISTRICT MIRPUR

10.1 General

The two southern most districts i.e., Mirpur and Bhimber have the construction practice similar to that of the Punjab Plains in Pakistan. The public and private buildings are mostly constructed by the burnt bricks. Many brick kilns are operative in the districts and a substantial portion of the demand is also met from the nearby kilns in Punjab.

The bedrock suitable for the construction material is scarce; however abundant stream bed deposits are available having potential for concrete and road aggregate.

Considering the district's geographic location and the geology, a comprehensive construction material study was conducted. The study included assessment of area potential, identification of all existing and potential sources, qualitative evaluation, and accordingly determining their suitability for use as construction material for buildings, roads and bridges. Since the original TOR only covers the aggregate and stone potential, there the investigation excludes the clay silt deposits for establishing their suitability for burnt bricks.

This chapter provides details of explorations, evaluations, and suitability assessments of all source's studies in district Mirpur. The adequacy of construction material on district level is also discussed, which would serve as a realistic basis for preparing material procurement plan for the district.

10.2 Administrative Setup and Physiography

District Mirpur extends over an area of 1,010 km² (390 square mile), which hosts a population of about 333,482 persons (1998 Census- 1999 Projection). It shares inter-district boundaries with Kotli district in north and Bhimber in south. In the west, it is bounded by Punjab (Pakistan). About 20 % area of the district is inundated by the Mangla Dam Reservoir.

The district comprises three tehsils, namely Dhudial, Chakswari and Mirpur. Mirpur city is the districts headquarter. The other tehsil headquarters are Dhudial and Chaksawari. The other main towns include Islamgarh, Jattlan, and Kakra. All these towns are well connected through metaled roads.

The district forms part of Lesser Himalayan Zone, and its topography is mainly low to moderate high with valleys in between, however the eastern part of the district is mainly plain. The elevation ranges from 236 meters to 963 meters. The main rivers of the district are Jhelum and Poonch, which feed the Mangla reservoir. No major tributary drains the Poonch and Jhelum catchment in the district upstream of the reservoir. Kanali Kas, Haran Da Kas, and Ghanoi Kas are the major streams feeding the Mangla Reservoir. Many other major streams like Jari Kas, Sukhater, and Mangla Jatlian meets the Jhelum river downstream of dam in Punjab Province.

The climate within the district does not vary however; the district is very cold in winter and hot in summer, while the western part remains cold in winters and hot in summers. May, June and July are the hottest months, while December, January and February are the coldest months. The maximum and minimum temperatures in the month of January vary between 16°C and 0°C, while the same in the month of June vary between 40°C and 22°C respectively. The annual precipitation rate is about 1500 millimeters.

Mirpur city is located at a distance of about 100 km from Kotli city via Chakswari and about 110 km from Islamabad via Mangla Dina. Islamabad.

Fig. 10.1 shows the administrative and physiographic details of Mirpur district.

10.3 Geology

The district Mirpur is the part of Sub-Himalayan range, dominantly occupies low relief hills of fresh water deposited rocks of Siwalik Group and overlying Soan Formation. The Siwaliks were deposited in geosynclines, in front of rising mountains by the streams rejuvenated by this major uplift initiated in the Miocene epoch. That geosyncline was more northerly orientated than of the Indo-Ganges, in which now-a-days the sediments are being deposited. The 2nd orogenic phase discontinued the course of streams followed by a major depositional event which results the deposition of Soan Formation of the Siwalik Group.

The most dominant structure of the district Mirpur is the Mirpur Syncline forming an elongated basin trending northwest. The syncline is bounded by the anticline on both sides. The syntaxial bend, which is very sharp near Mirpur, dies out in the south of Mangla.

Lithologically, the Siwaliks consists of intercalated beds of sandstone, siltstone and clay in the lower part; in the upper parts, conformable gravel beds also occur. Some of the beds are over 100 feet in thickness and can be traced individually over a long distance. Since these deposits are fresh water origin, most of the thinner beds are lenticular and pinch out rapidly there can be considerable lateral variation. The maximum thickness of the Siwalik strata in Mirpur syncline is 4572 m.

The sandstone beds are fine to medium grained and 90% of the beds are so poorly cemented that these can be crumbled under the fingers. The remaining 10% form hard lenticular masses/ribs of better cemented sandstone.

Soan Formation is mainly consisting of Pleistocene gravels, mostly quartzite, with subordinate lithologies of limestone, sandstone and lithic-arenite. The streams originating and draining the Soan horizons are rich in the gravels derived from the Soan Formation.

A substantial part of the district is also covered by the recent deposits, mainly silt and riverbed deposits. A simplified geological map is presented as **Fig. 10.2**.

10.4 Construction Material Prospecting

The geologic formations exposed within the district were carefully evaluated for their potential with respect to procurement of material for construction of buildings, bridges and roads. For this purpose, the geologic formations were categorized with respect to the broad engineering characteristics of various rock types presented as **Fig 10.3**.

- A major part of the area is inundated by the Mangla reservoir. The bedrock exposed in the area has no prospect for concrete and asphalt aggregate as well as other major construction material required. The formations of Siwalik Group belong to this category.
- The Soan Formation also covers a substantial part of the district. This formation comprises mainly of gravels, which have relatively high prospect as construction material source.
- Area covered with Quaternary deposits comprising mainly flood plain, terrace deposits and silt etc. occupies about 50% of the land. Amongst these, only the

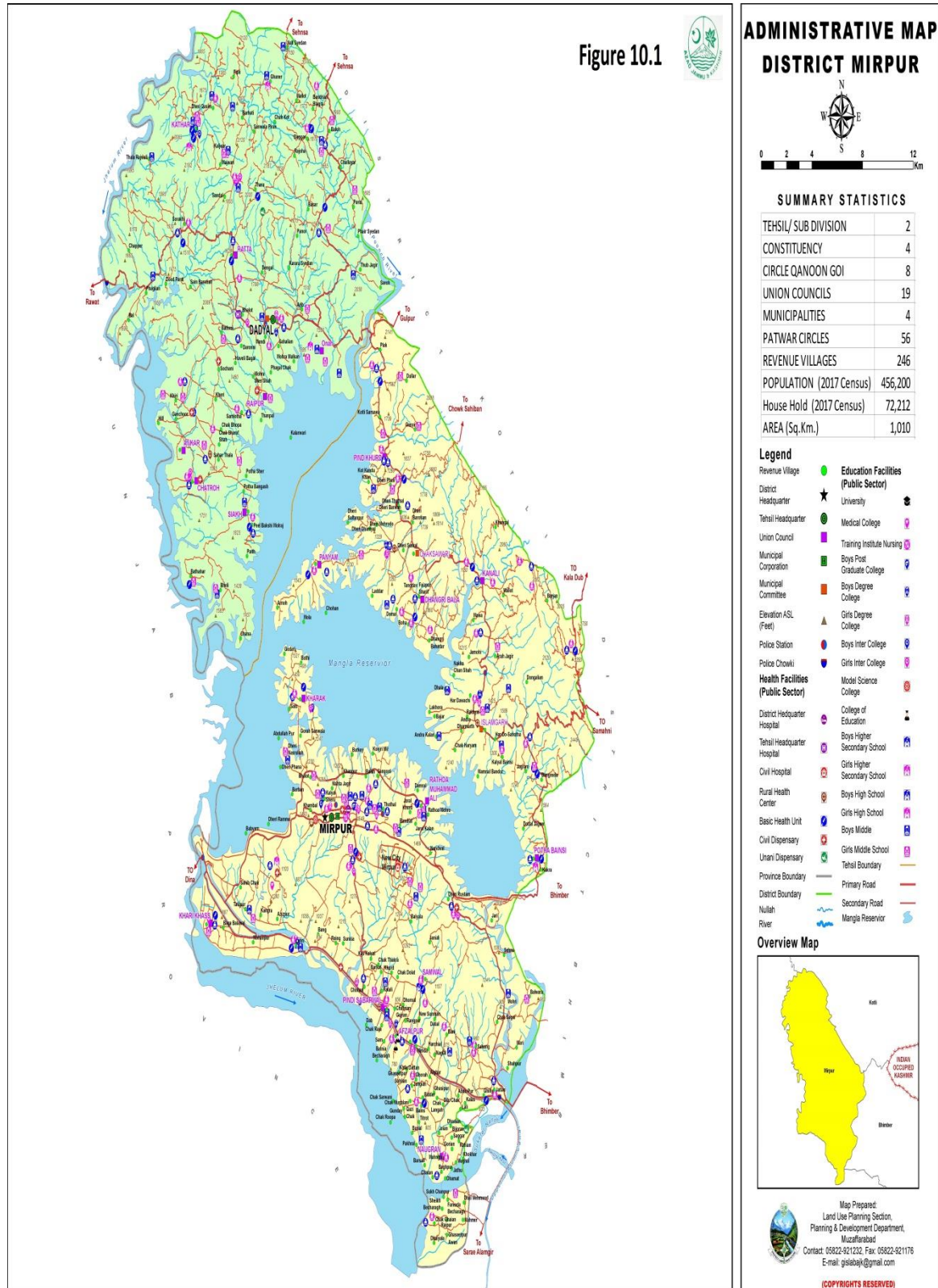


Figure 10.1: Administrative and Physiographic Details of District Mirpur

Geological Map of District Mirpur

Figure-10.2

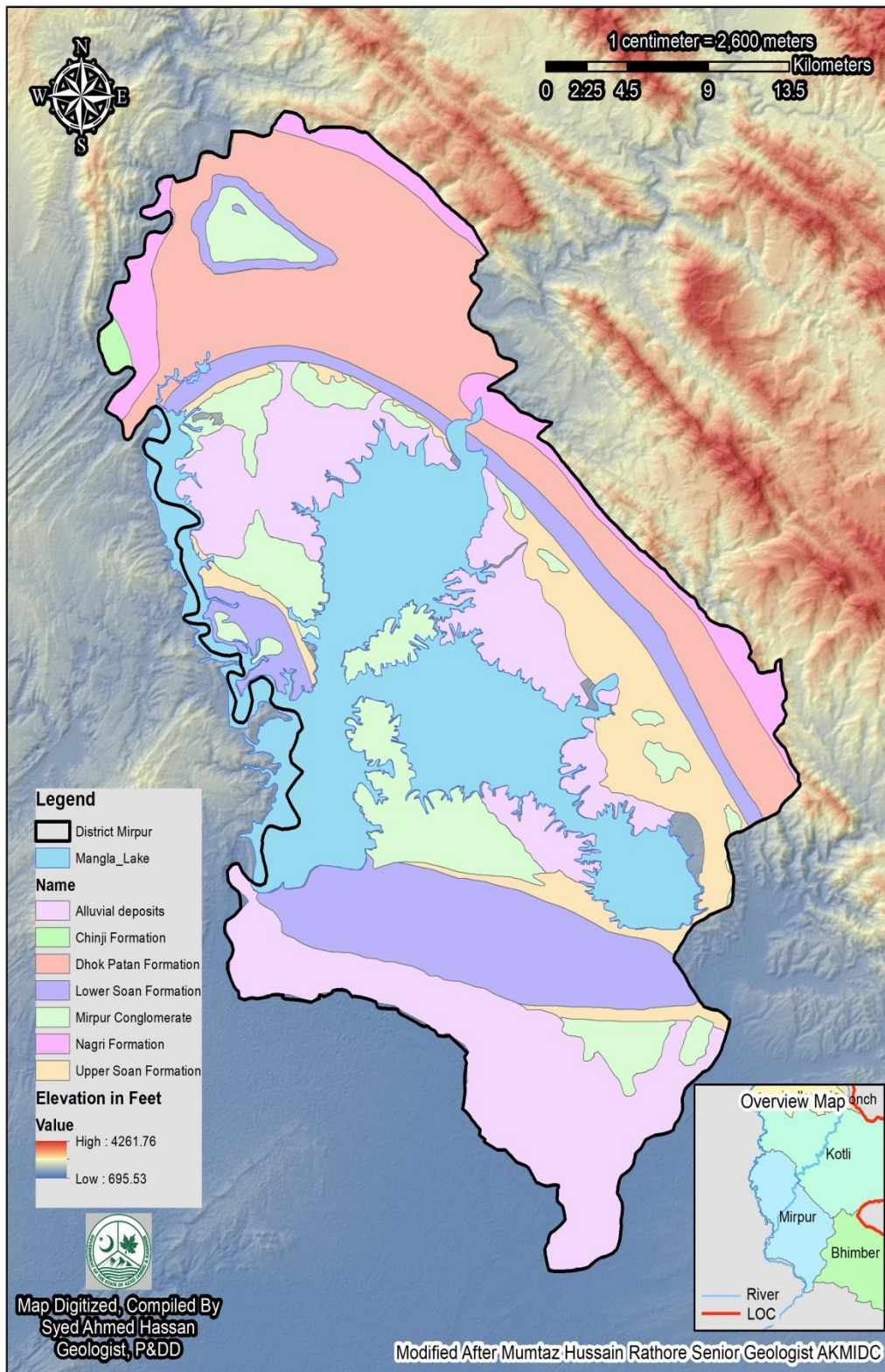


Figure 10.2: Geological Map of District Mirpur

Sample Location Map, District Mirpur

Figure-10.3

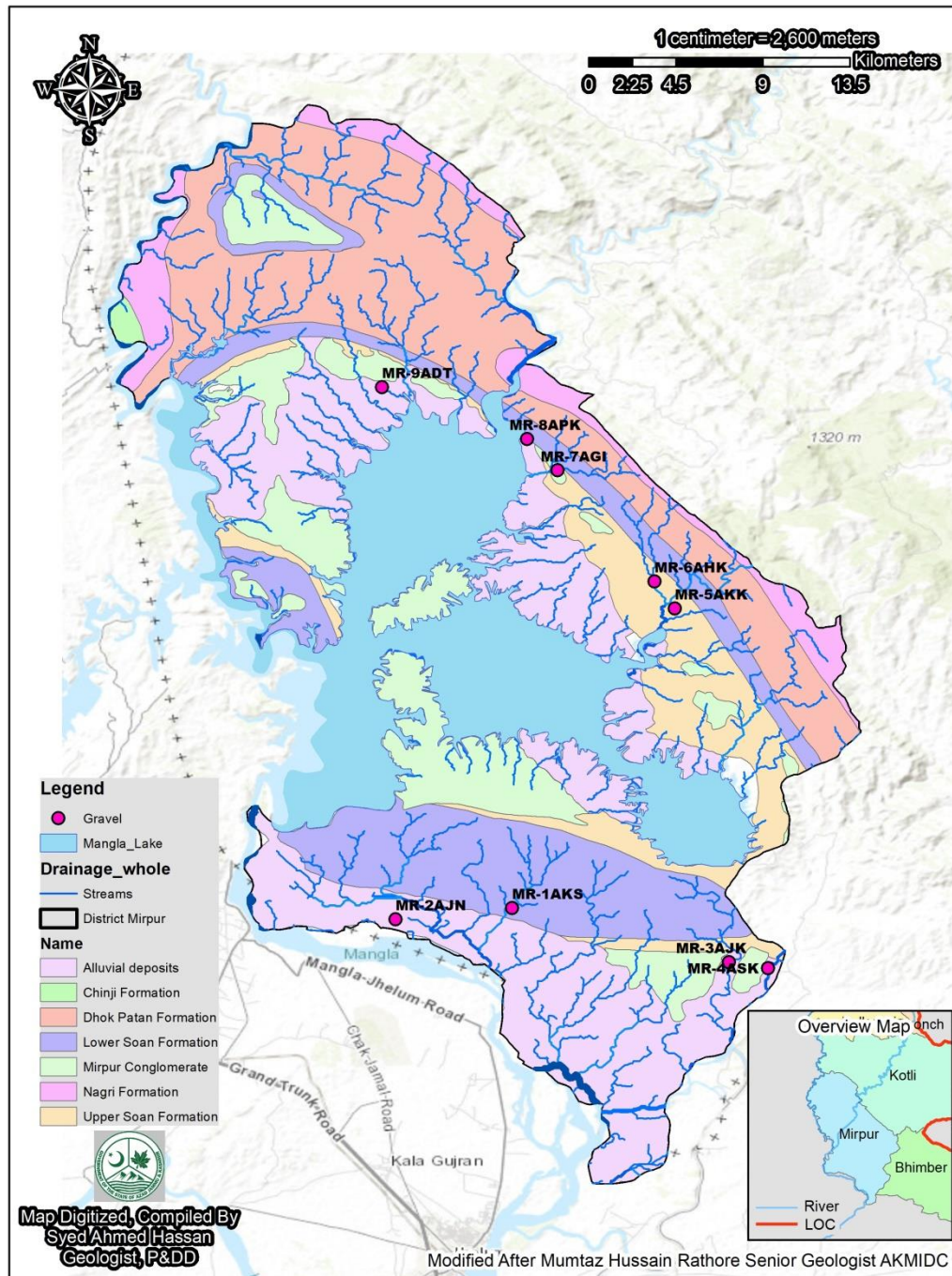


Figure 10.3: Sample Location Map of District Mirpur

- river bed and few terraces have prospects for construction material depending upon the rocks exposed in the stream catchments.

10.5 Exploration for Construction Material Sources

A comprehensive exploration program for identifying material suitable for use in construction of buildings, roads and bridges was executed in the entire district. The program was based on the local physiographic conditions, assessment of geology and material prospecting, existing sources, relevant deficiencies and State needs. The program activities included systematic identification of sources, preliminary field demarcations and assessments, comprehensive sampling, qualitative and quantitative assessments and rapid environmental examination. These activities were conducted in accordance with the criteria and methodology stated in the previous sections.

Around Mangla Dam Reservoir, gravel rich horizons of Soan Formation are well exposed. These gravel deposits are being extracted and crushed by a large number of crushers. The composition of the crushed aggregate is variable. The aggregate is mainly composed of white, off-white and lilac colored quartzite with subordinate limestone, sandstone, chert and meta-basalt.

Silt/clay for brick making is being procured from various localities within the district and the details are given in Appendix-2.

The district gravel and hard rock material potential can be categorized in the following major sources:

10.5.1 Poonch River and Tributaries Gravel

Poonch river is the main astray of the Kotli and Mirpur districts. The river originates from the Indian Held Kashmir and enters in Azad Kashmir in Poonch district.

A major part of the river catchment is Pir Panjal Range of Indian held Kashmir. Throughout its length, the river carries abundant bed load in the form of silt, fine sand, gravel, cobbles and boulders. The river drains three districts and terminates in the Mangla Reservoir near Dodial (Chakswari) in Mirpur district.

About 40% length of Poonch river traverses through the Mirpur district. In this reach, the river flows in narrow valley and is not productive in terms of aggregate manufacturing. However, before terminating in Mangla reservoir, three major tributaries having huge material potential join the Poonch River within the district boundary. The tributaries include the following, which have been investigated as potential material source:

- Kanali-Kas Nullah Gravel
- Har-Kas Nullah Gravel, Islamgarh
- Ganoi Kas Nulah- Terrace Deposits, Chaksawari

10.5.2 Poonch River Terrace Deposits

Part of the Poonch river in Mirpur district itself carries no bed load enough to be considered for opening a source. However huge terrace deposits near Kot Sarsawa, Chakswari are present, which is an existing source. The source is located near Kot Sarsawa and Chaksawari.

10.5.3 Jhelum River Tributaries Gravel and Sand

Only the tributaries of Jhelum river in Mirpur district are productive in terms of material exploration. A large portion of Jhelum river in the district is inundated by the Mangla Reservoir and as such is not accessible and feasible for the material exploration, though a huge quantity of Jhelum river bed material, upstream of the Mangla spillway has been used for the construction of Mangla Dam.

The following tributaries of Jhelum river in the district have been investigated and sampled for further investigations.

- Khari Sharif Terrace / Nullah, Mirpur
- Mangla Jatli Terrace Gravel, Mirpur
- Jeri-Kas Nullah Gravel, Mirpur
- Saketar Nullah Gravel, Mirpur
- Jatilan Sand Deposits, Mirpur

10.5.4 Palak Sandstone Mirpur

No bedrock exposures, hard enough to be qualified as aggregate source are found in Mirpur district. However, samples were collected from Soan Formation near Palak, during the field investigation. The locations of these sources are shown in **Fig.10.4**.

10.6 Source Digests

Detailed information pertinent to any individual source is put together in the form of "Source Digest". The information for each source relates to (a) location and accessibility, (b) physiographic and geologic conditions, (c) environmental appraisal, (d) extent of investigations conducted, (e) summary results of investigations, (f) principal evaluations, and (g) recommendations. The source digests are organized alpha-numerically for efficient tracking of information.

The information provided in the respective source digests form basis for the analyses and procurement plans. These source digests have been provided separately.

10.7 Suitability of the Investigated Sources

A careful evaluation of the 11 investigated sources was conducted to establish their suitability in broad terms as construction material. The evaluation was made in strict compliance to the criteria stated in Chapter 4. A summary of the evaluation results is given below:

- 1 No rock source has been rated as suitable for quarrying coarse aggregate.
- 2 Ten (10) nullah/terrace gravel sources have been rated as suitable for borrowing coarse aggregate for producing (a) concrete of low-strength (b) base/ sub-base road elements.
- 3 No sandstone sources have been rated as suitable for quarrying stone for various masonry works and soling material for road works.
- 4 An extensive source of fine to medium grained sand i.e., Jatilan Nullah is identified downstream of Jatilan Headwork's.
- 5 The detail of silt/clay sources for brick making is provided in Appendix-2.

10.8 Recommended Uses of Suitable Sources

The sources declared suitable have varying petrographic, physical and engineering characteristics. A cautious evaluation of the characteristics of each source was carried out to identify its appropriate uses as construction material in light of the Composite

Schedule of Rates for AJ&K. Based on this evaluation, the recommended uses of all the sources for various construction types are indicated in **Table.10.1**.

%age area Distribution w.r.t. Construction Material Prospect, District Mirpur
Figure-10.4

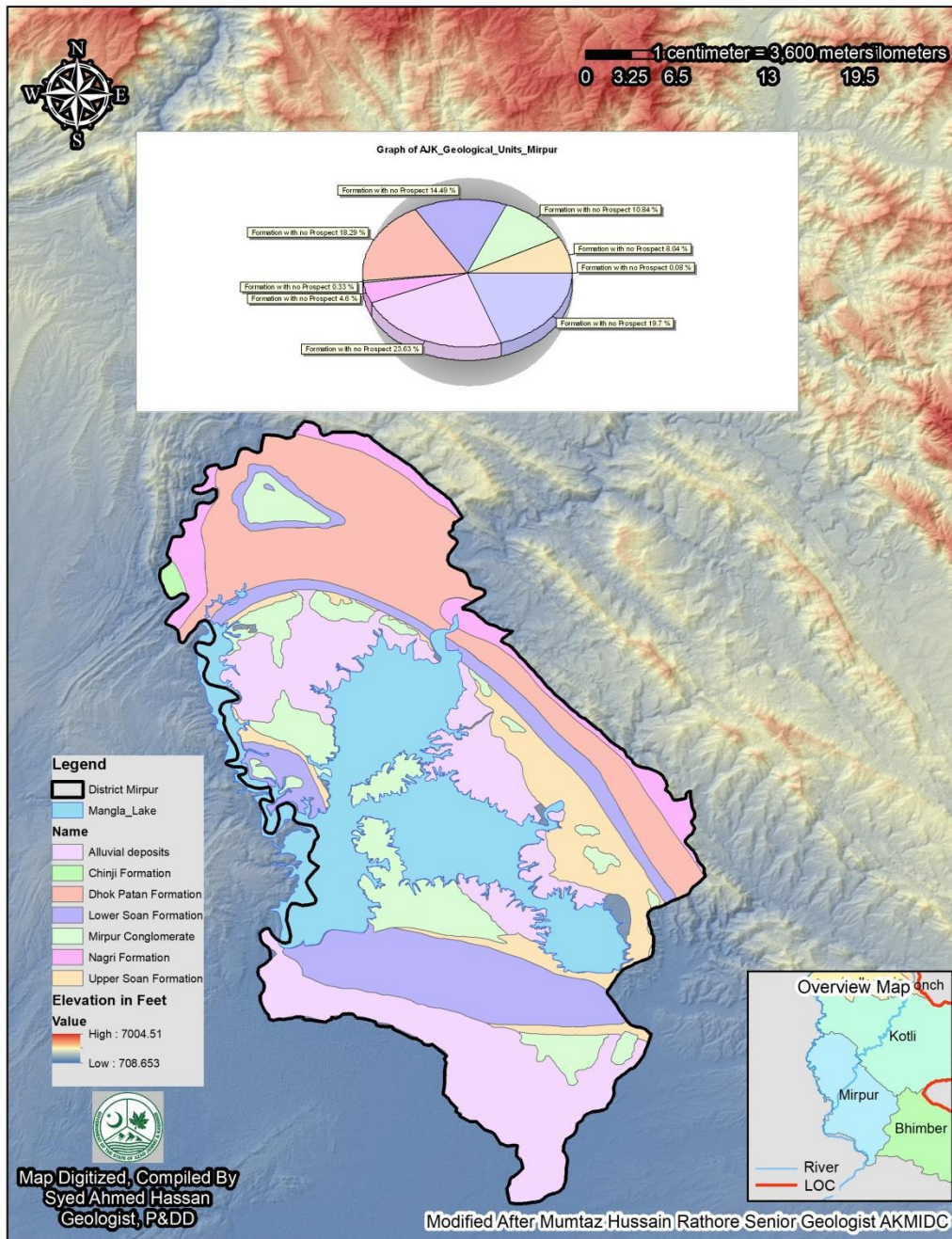


Figure 10.4: Construction Material Prospects of District Mirpur

CONSTRUCTION MATERIAL SOURCES IN AND AROUND AZAD JAMMU & KASHMIR
TABLE 10.1
 Recommended Uses of Various Material Sources in District Mirpur

QUARRY NAME	Source Code	TYPE OF CONSTRUCTION																													
		STRUCTURES WITH GREATER LIFE RISK												STRUCTURES WITH LESS LIFE RISK						ROADS											
		Private Houses and Public Buildings (Max. Two Storey Schools, BHU, etc.)						Major Public Buildings (Colleges, Hospitals and Bridges etc.)						Causeways		Culverts		Concrete		Masonry walls		Inter-district Roads	Intra-district Roads	Community Roads							
		Stone	Non-Load Bearing Concrete Blocks	Load Bearing Concrete Blocks (2000 psi)	Lean Concrete	Concrete upto 2000 psi	Concrete 2000-4000 psi *	Stones	Non-Load Bearing Concrete Blocks	Load Bearing Concrete Blocks (2000 psi)	Lean Concrete	Concrete upto 2000 psi	Concrete 2000-4000 psi *	High Strength Concrete	Pre-stressed Concrete	Stone	Lean Concrete	Concrete (Upto 3000 psi) *	Stone	Lean Concrete	Reinforced Concrete (3000psi) □	Lean Concrete	Concrete (Upto 3000 psi) *	Stones	Lean Concrete	Concrete (3000 psi) *	Base / Sub Base	Asphalt Layer	Sub Base / Soling	Asphalt Layer	Soling
Khari Sharif	MR-1	x	✓	✓	✓	✓	x	✓	✓	✓	✓	x	x	x	x	✓	✓	✓	✓	✓	✓	x	✓	✓	✓	✓	x	✓	x	x	x
Mangla Jatli	MR-2	x	✓	✓	✓	✓	x	✓	✓	✓	✓	x	x	x	x	✓	✓	✓	✓	✓	✓	✓	x	✓	✓	✓	x	✓	x	x	x
Jeri Kas	MR-3	x	✓	✓	✓	✓	x	✓	✓	✓	✓	x	x	x	x	✓	✓	✓	✓	✓	✓	✓	x	✓	✓	✓	x	✓	x	x	x
Saketar	MR-4	✓	✓	✓	✓	✓	x	✓	✓	✓	✓	x	x	x	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	x	✓	x	✓	x
Kanali Kas	MR-5	x	✓	✓	✓	✓	x	✓	✓	✓	✓	x	x	x	x	✓	✓	✓	✓	✓	✓	✓	x	✓	✓	✓	x	✓	x	x	x
Har Kas	MR-6	x	✓	✓	✓	✓	x	✓	✓	✓	✓	x	x	x	x	✓	✓	✓	✓	✓	✓	✓	x	✓	✓	✓	x	✓	x	x	x
Ganoi Kas	MR-7	x	✓	✓	✓	✓	x	✓	✓	✓	✓	x	x	x	x	✓	✓	✓	✓	✓	✓	✓	x	✓	✓	✓	x	✓	x	x	x
Kot Sarsawa	MR-8	x	✓	✓	✓	✓	x	✓	✓	✓	✓	x	x	x	x	✓	✓	✓	✓	✓	✓	✓	x	✓	✓	✓	x	✓	x	x	x
Dudial terraces	MR-9	x	✓	✓	✓	✓	x	✓	✓	✓	✓	x	x	x	x	✓	✓	✓	✓	✓	✓	✓	x	✓	✓	✓	x	✓	x	x	x

Suitable ✓ Project Specific Studies including Mix Design ▲ Not Suitable x

The recommendations are based on the presumption that the available cement type in the State is Ordinary Portland Cement.

Requires Mix Design in Recommended Case *

CONTINUED ON NEXT PAGE

CONSTRUCTION MATERIAL SOURCES IN AND AROUND AZAD JAMMU & KASHMIR
TABLE 10.1

Recommended Uses of Various Material Sources in District Mirpur

NOTES:

1. The sources contain invariably varied proportion of reactive constituents. The aggregate may or may not be ASR susceptible depending on the percentage of reactive constituents. However, it is recommended to use the aggregate in concrete when the total alkalis from all sources do not increase the threshold value of 2.5 kg per cubic meter of concrete.
2. Material suitability of very high strength and prestressed concrete shall be established on the basis of actual concrete mix design
3. The sources are recommended for base/sub base aggregate, if the percentage of rounded faces of crushed aggregate are within the permissible limit of specifications.
4. The sources can be used for concrete with the following options if declared non recommended on the basis of ASR susceptibility, however this require source specific study.
 - i). Low Alkali Cement (Alkalis as Na_2O less than 0.4%)
 - ii). Slag Cement or Pozzolanic Cement
 - iii). Using Slag, Fly Ash or Silica Fume as Partial Replacement with the OPC
5. The reactive aggregates are being recommended for few concrete classes keeping in view that the cement content in such concrete is quite low. The total alkalis in concrete will not increase the threshold level of 2.5kg/ cu.m.
6. The boulders of Saketar nullah (10 inch size) can be used as soling stone.

CHAPTER 11

CONSTRUCTION MATERIAL SOURCES STUDY OF DISTRICT BHIMBER

11.1 General

The district Bhimber shares a similar terrain and geology to that of Mirpur district and has identical construction practices and material availability issues. The construction material investigations were therefore conducted in accordance with the Terms of Reference and the in the light of experiences shared by the State officials representing both the southernmost districts. The study included assessment of area potential, identification of all existing and potential sources, qualitative evaluation, and accordingly determining their suitability for use as construction material for buildings, roads and bridges.

This chapter provides details of explorations, evaluations, and suitability assessments of all source's studies in district Bhimber. The adequacy of construction material on district level is also discussed, which would serve as a realistic basis for preparing material procurement plan for the district.

11.2 Administrative Setup and Physiography

District Bhimber is the southernmost district of AJ&K and extends over an area of 1,516 km² (390 square mile), which hosts a population of about 301,633 persons (1998 Census- 1999 Projection). The district is bounded by Mirpur district to the northwest (and is 50 km from Mirpur city), and Punjab province in the west and south. It also shares borders with Indian occupied Kashmir to the east.

The district comprises three tehsils, namely Bhimber, Samani and Barnala. Bhimber city is the districts headquarter. All these towns are well connected through metaled roads.

The district forms part of Lesser Himalayan Zone, and its topography is mainly low to moderate high with valleys in between, however the eastern part of the district is mainly plain. The elevation ranges from 227 meters to 1221 meters. The main streams of the district are Bhimber and Samani nullahs.

The southern zone Mirpur Division (i.e., the Bhimber District) has a similar climate to the neighboring areas of Punjab, hot summer temperature is often over 45°C from May to September and cold winter, and rain fall is concentrated in the monsoon between late June to the end of August. There is often a prolonged dry period from October to early January followed by winter's rains from mid-January to March.

Bhimber city is located at a distance of about 50 Km from Mirpur city and 25 km from Gujrat. Islamabad is located at a distance of 166 Km.

Fig. 11.1 shows the administrative and physiographic details of Bhimber district.

11.3 Geology

The district Bhimber is the part of Sub-Himalayan range dominantly occupies low relief hills of fresh water deposited rocks of Siwalik Group. The Siwaliks were deposited in geosyncline in front of rising mountains by the streams rejuvenated by this major uplift initiated in the Miocene epoch. That geosyncline was more northerly orientated than of the Indo-Ganges in which now-a-days the sediments are being deposited. The 2nd orogenic phase discontinued the course of streams followed by a major depositional event which results the deposition of Soan Formation of the Siwaliks Group.

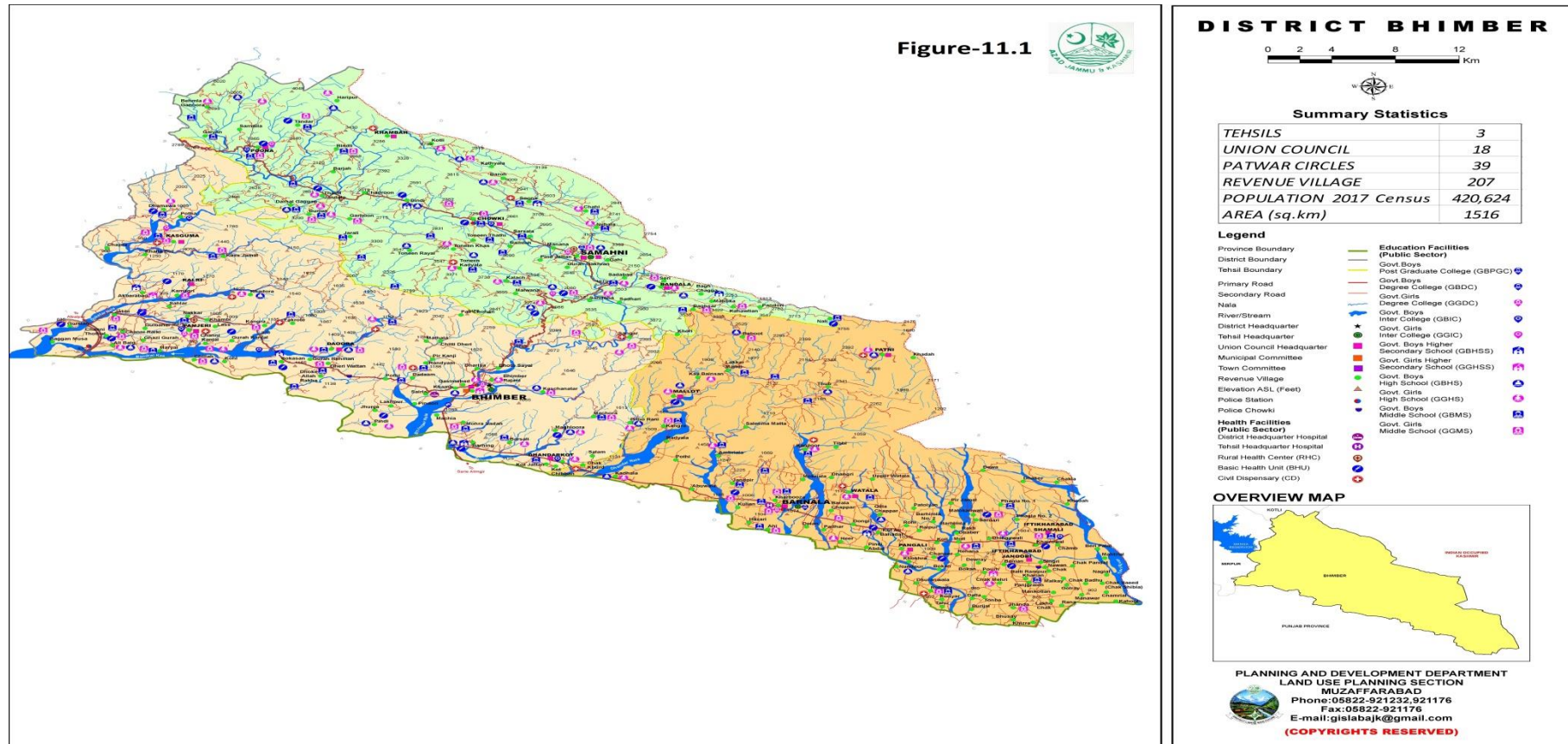


Figure 11.1: Administrative and Physiographic Details of District Bhimber

Lithologically, the Siwaliks consists of intercalated beds of sandstone, siltstone and clay in the lower part; in the upper parts, conformable gravel beds also occur. Some of the beds are over 100 feet in thickness and can be traced individually over a long distance. Since these deposits are fresh water origin, most of the thinner beds are lenticular and pinch out rapidly there can be considerable lateral variation. The maximum thickness of the Siwalik strata in Mirpur syncline is 4572 m.

The sandstone beds are fine to medium grained and 90% of the beds are so poorly cemented that these can be crumbled under the fingers. The remaining 10% form hard lenticular masses/ribs of cemented sandstone.

Soan Formation is mainly consisting of Pleistocene gravels mostly quartzite, with subordinate lithology of limestone, sandstone and lithic-arenite. The streams originating and draining the Soan horizons are rich in the gravels derived from the Soan Formation.

A Substantial part of the district is also covered by the recent deposits mainly the silt and riverbed deposits.

A simplified geological map of the district is presented as **Fig.11.2**.

11.4 Construction Material Prospecting

The geologic formations exposed within the district were carefully evaluated for their potential with respect to procurement of material for construction of buildings, bridges and roads and illustrated in **Fig 11.3**. For this purpose, the geologic formations were categorized with respect to the broad engineering characteristics of various rock types. A summary of the inferences derived from this simplified map is presented below:

The rocks belonging to Siwalik Group have no prospect for concrete and asphalt aggregate.

Soan Formation covers almost 10% of the total district area. This formation comprises mainly of gravels, which have relatively high prospect as construction material source.

Nearly 80-90% of the area is covered with Quaternary deposits comprising mainly flood plain, terrace deposits and silt etc. Amongst these, only flood plain deposits have prospects for construction material depending upon the rocks exposed in the stream catchments.

11.5 Exploration for Construction Material Sources

A comprehensive exploration program for identifying material suitable for use in construction of buildings, roads and bridges was executed in the entire district. The program was based on the local physiographic conditions, assessment of geology and material prospecting, existing sources, relevant deficiencies and State needs. The program activities included systematic identification of sources, preliminary field demarcations and assessments, comprehensive sampling, qualitative and quantitative assessments and rapid environmental examination. These activities were conducted in accordance with the criteria and methodology stated in the previous sections.

Around Mangla Dam Reservoir, gravel rich horizons of Soan Formation are well exposed. These gravel deposits are being extracted and crushed by a large number of crushers.

The composition of the crushed aggregate is variable. The aggregate is mainly composed of white, off white and lilac colored quartzite with subordinate limestone, sandstone, chert and meta-basalt.

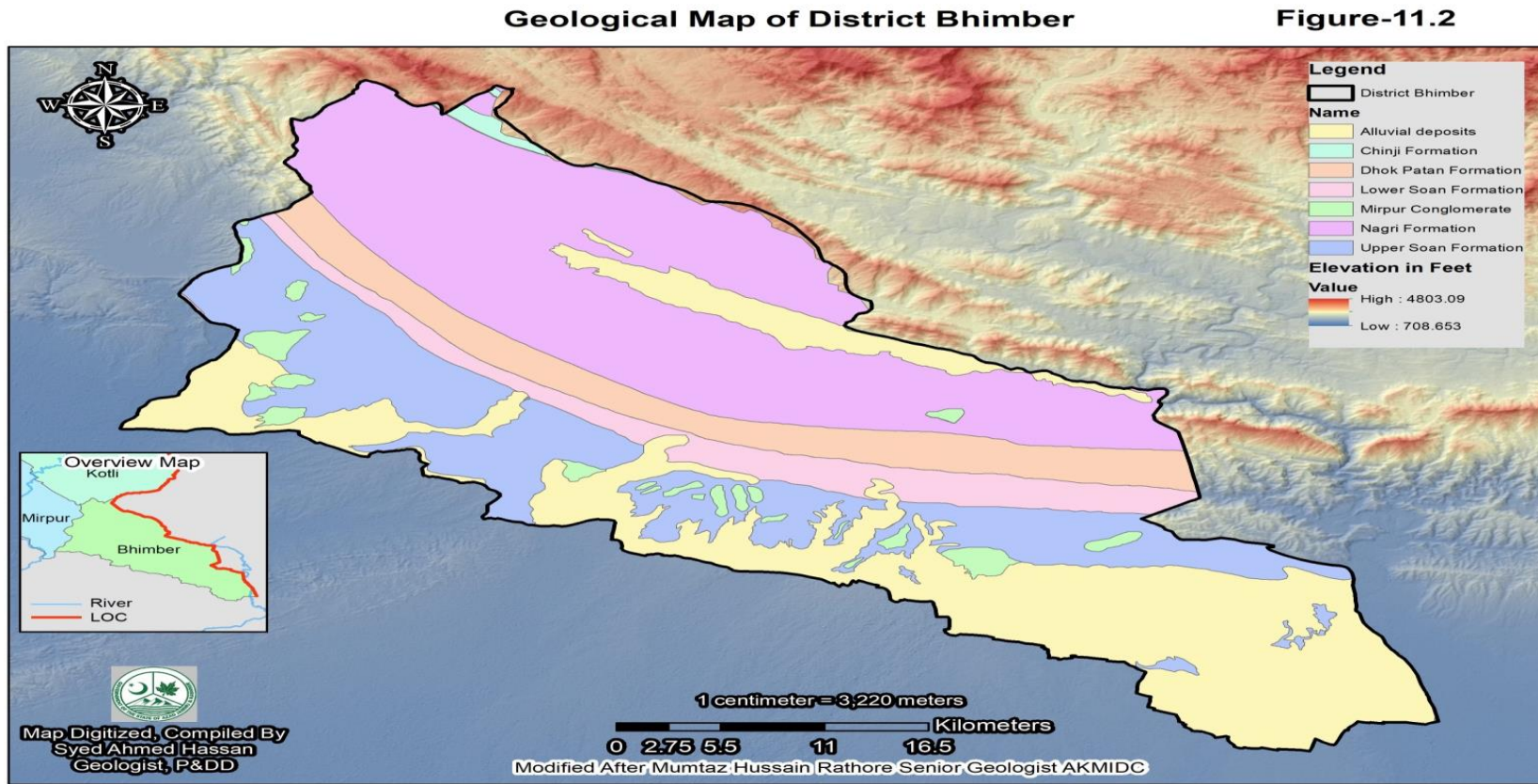


Figure 11.2: Geological Map of District Bhimber

Sample Location Map, District Bhimber

Figure-11.3

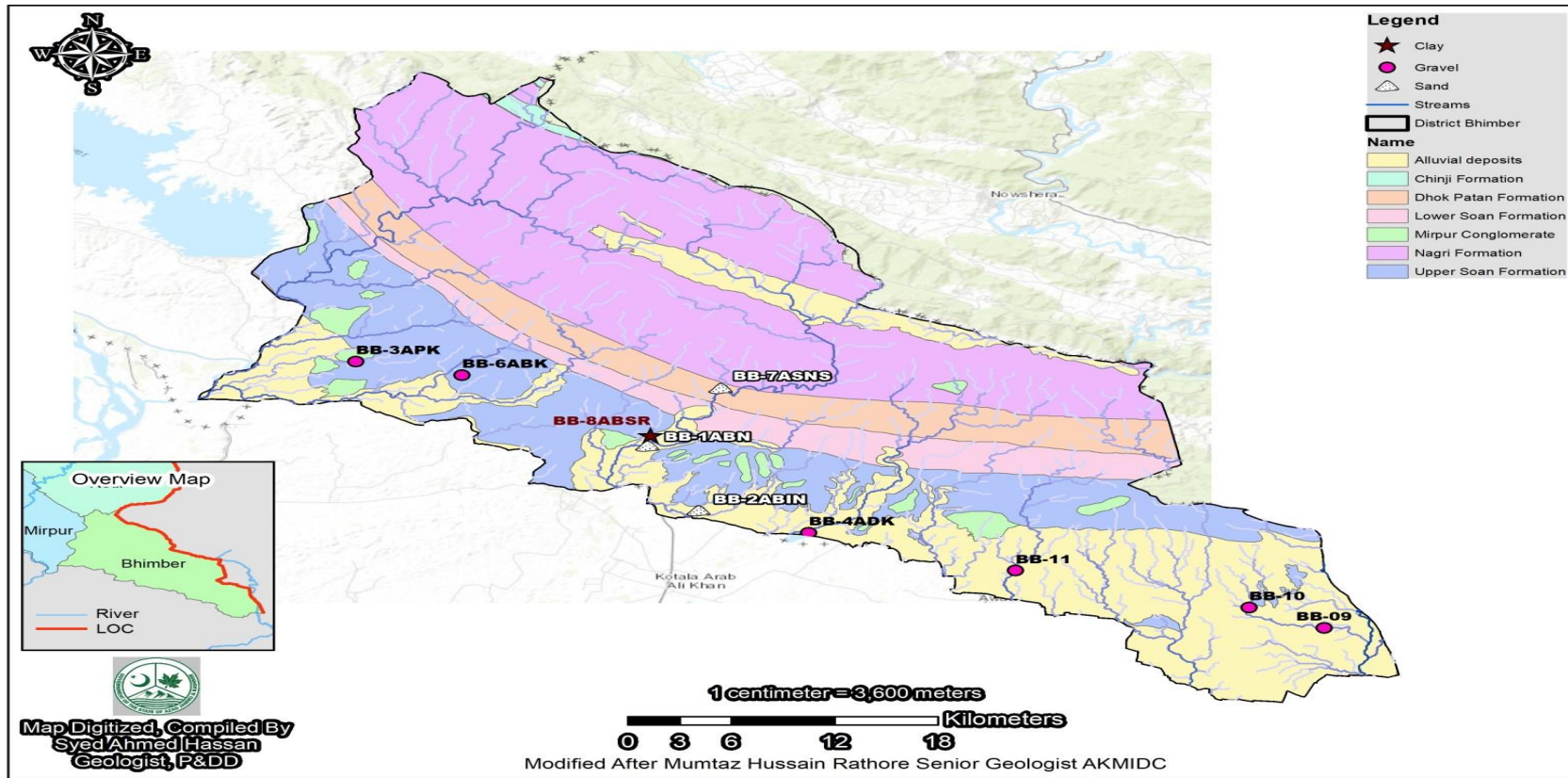


Figure 9.2: Sample Location Map of District Bhimber

The gravel and hard rock material potential of the district can be categorized in the following major sources:

The entire district; is drained by a number of nullahs which carries a substantial bed load being exploited for various uses.

11.5.1 Nullahbed Sources/ Terrace Deposits

- Bhimber Nullah
- Bhring Nullah
- Dhandar Nullah
- Khadala Nullah
- Chaprian Nullah
- Samani Nullah

Eight (08) locations were selected for sampling. Samples from each location of these sources have been collected.

11.5.2 Bedrock

The Siwalik Group comprises formations having friable sandstone and clay stone, are also distributed in the area. These formations have no value as aggregate.

Chinji Formation

Chinji Formation is widely distributed in the district. Two samples of the clay stone were collected from a rock face on Bhimber- Samani road for finding the suitability of the material for brick making.

Dhok Pathan Formation

Dhok Pathan Formation consists of friable sandstone. No sampling has been done as the field observation shows its unsuitability for any use. %age formations are reflected as **Fig. 11.4.**

11.6 Source Digests

Detailed information pertinent to any individual source is put together in the form of "Source Digest". The information for each source relates to (a) location and accessibility, (b) physiographic and geologic conditions, (c) environmental appraisal, (d) extent of investigations conducted, (e) summary results of investigations, (f) principal evaluations, and (g) recommendations. The source digests are organized alpha-numerically for efficient tracking of information.

The information provided in the respective source digests form basis for the analyses and procurement plans.

11.7 Suitability of the Investigated Sources

A careful evaluation of the eight (08) investigated sources was conducted to establish their suitability in broad terms as construction material. The evaluation was made in strict compliance to the criteria stated in Chapter 4. A summary of the evaluation results is given below:

%age area Distribution of Geological Formations w.r.t Construction Material Prospect, District Bhimber

Figure-11.4

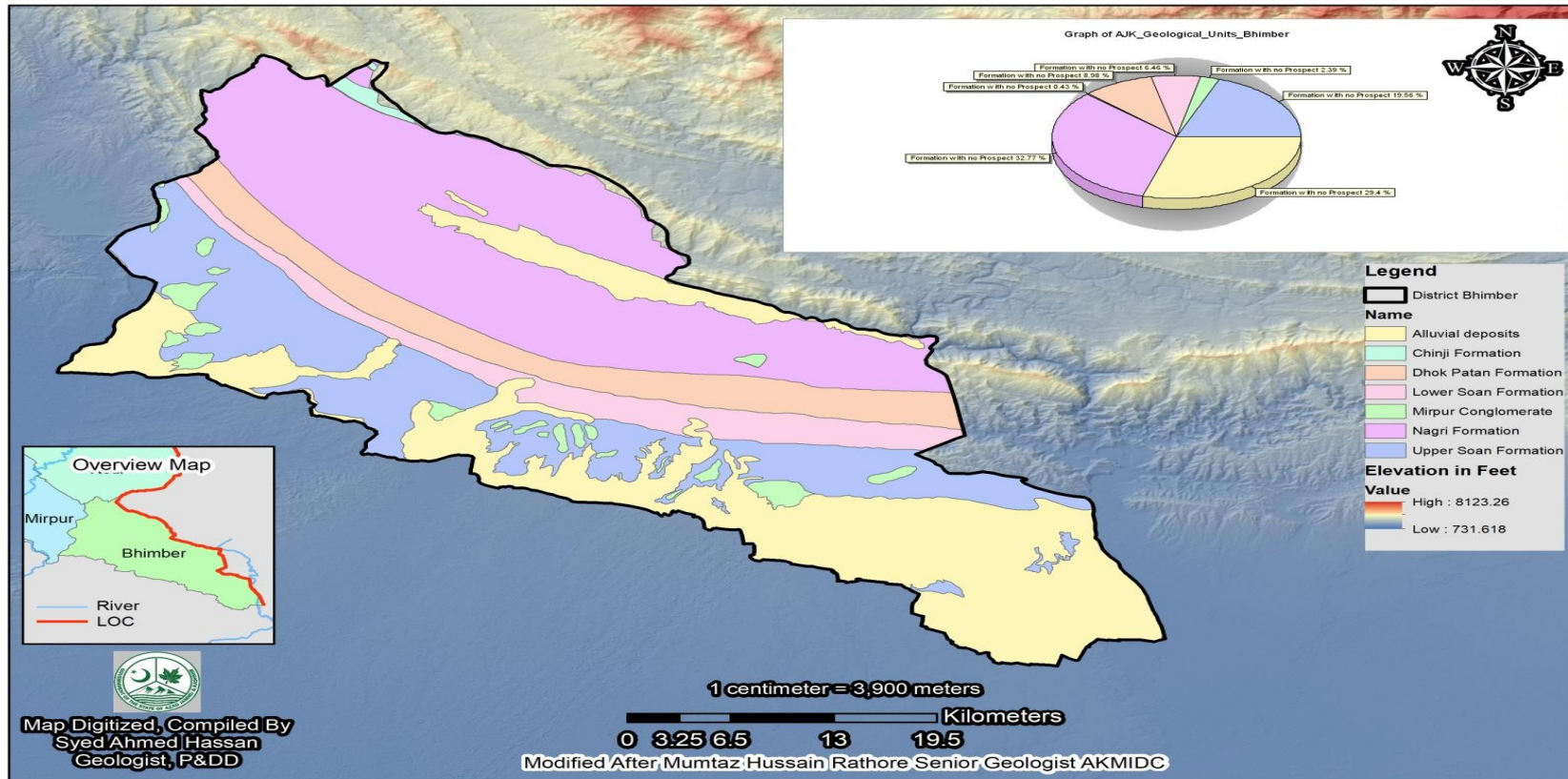


Figure 11.4: Construction Material Prospects of District Bhimber

- 1 Seven (07) alluvial gravel and sand sources have been rated as suitable for borrowing coarse and fine aggregate for producing (a) concrete of low-strength (b) base/ sub-base road elements.
- 2 No sandstone sources have been rated as suitable for quarrying stone for various masonry works and soling material for road works.
- 3 For local sand of district Bhimber refer correlation chart of nullah sand in main study area with ASTM standards curves as shown in Chapter 17.
- 4 The detail of silt/clay sources for brick making is provided in **Appedix-2**.

Detailed comments concerning the suitability of each explored sources is made in the respective "Source Digest".

11.8 Recommended Uses of Suitable Sources

The sources declared suitable have varying petrographic, physical and engineering characteristics. A cautious evaluation of the characteristics of each source was carried out to identify its appropriate uses as construction material in light of the Composite Schedule of Rates for AJ&K.

Based on this evaluation, the recommended uses of all the sources for various construction types are indicated in **Table. 11.1**. Necessary precautions for quarrying and borrowing, from these sources are given in respective "Source Digest".

CONSTRUCTION MATERIAL SOURCES IN AND AROUND AZAD JAMMU & KASHMIR
TABLE 11.1

Recommended Uses of Various Material Sources in District Bhimber

QUARRY NAME	Source Code	TYPE OF CONSTRUCTION																													
		STRUCTURES WITH GREATER LIFE RISK											STRUCTURES WITH LESS LIFE RISK						ROADS												
		Private Houses and Public Buildings (Max. Two Storey Schools, BHU, etc.)						Major Public Buildings (Colleges, Hospitals and Bridges etc.)					Causeways		Culverts		Concrete	Masonry walls	Inter-district Roads	Intra-district Roads	Community Roads										
		Stone	Non-Load Bearing Concrete Blocks	Load Bearing Concrete Blocks (2000 psi)	Lean Concrete	Concrete upto 2000 psi	Concrete 2000-4000 psi*	Stones	Non-Load Bearing Concrete Blocks	Load Bearing Concrete Blocks (2000 psi)	Lean Concrete	Concrete upto 2000 psi	Concrete 2000-4000 psi*	High Strength Concrete	Pre-stressed Concrete	Stone	Lean Concrete	Concrete (Upto 3000 psi)*	Stone	Lean Concrete	Reinforced Concrete (3000psi)✓	Lean Concrete	Concrete (Upto 3000 psi)*	Stones	Lean Concrete	Concrete (3000 psi)*	Base / Sub Base	Asphalt Layer	Sub Base / Soling	Asphalt Layer	Soling
Panjari Nullah	BB-1	x	✓	✓	✓	✓	x	✓	✓	✓	✓	x	x	x	x	✓	✓	x	✓	✓	✓	✓	x	✓	✓	✓	x	✓	x	x	x
Dhandar Nullah	BB-2	x	✓	✓	✓	✓	x	✓	✓	✓	✓	x	x	x	x	✓	✓	x	✓	✓	✓	✓	x	✓	✓	✓	x	✓	x	x	x
Chaprian	BB-3	x	✓	✓	✓	✓	x	✓	✓	✓	✓	x	x	x	x	✓	✓	x	✓	✓	✓	✓	x	✓	✓	✓	x	✓	x	x	x
Suitable ✓		Project Specific Studies including Mix Design											▲ Not Suitable x						Requires Mix Design in Recommended Case *												

The recommendations are based on the presumption that the available cement type in the State is Ordinary Portland Cement.

NOTES:

1. The sources contain invariably varied proportion of reactive constituents. The aggregate may or may not be ASR susceptible depending on the percentage of reactive constituents. However, it is recommended to use the aggregate in concrete when the total alkalis from all sources do not increase the threshold value of 2.5 kg per cubic meter of concrete.
2. Material is unsuitable for very high strength and prestressed concrete.
3. The sources can be used for concrete with the following options if declared not recommended on the basis of ASR susceptibility, however this require source specific study.
 - i). Low Alkali Cement (Alkalis as Na₂O less than 0.4%)
 - ii). Slag Cement or Pozzolanic Cement
 - iii). Using Slag, Fly Ash or Silica Fume as Partial Replacement with the OPC
4. The sources are recommended for road aggregate, if the percentage of rounded faces of crushed aggregate are within the permissible limit of specifications.
5. The reactive aggregates are being recommended for few concrete classes keeping in view that the cement content in such concrete is quite low. The total alkalis in concrete will not increase the threshold level of 2.5kg/ cu.m.

CHAPTER 12

CONSTRUCTION MATERIAL SOURCES STUDY OF DISTRICT NEELUM

12.1 General

District Neelum is the northernmost district of the State and it differs in many aspects from the rest of the region i.e., i.) it is hill locked, only accessible through passing the Muzaffarabad district, ii) the geological set up is mostly igneous/metamorphic in nature and iii) the major target areas of material consumptions are only confined to the banks of Neelum River. These aspects have been considered while executing the study. Like other districts the study included assessment of area potential, identification of all existing and potential sources, qualitative/ quantitative evaluation, and accordingly determining of their suitability for use as construction material for buildings, roads and bridges.

This chapter provides details of explorations, evaluations, and suitability assessments of all source's studies in district Neelum. The adequacy of construction material on district level is also discussed, which would serve as a realistic basis for preparing material procurement plan for the district.

12.2 Administrative Setup and Physiography

District Neelum extends over an area of 3621 km², which hosts a population of about 191,251 inhabitants (2017 Census). It shares inter-district boundaries with Muzaffarabad in south & southwest and northern areas in north respectively. In the east and northeast, it is bordered by "Line of Control" with India.

The district comprises two tehsils, including Athmaqum and Sharda. Athmaqum is also the district headquarter. The other main towns include Kel, Dawarian, Luat, Malik Seri, Khawaja Seri, Sharda, Shaikh Bela, Helmet, Salkhala and Jura.

The district forms part of sub Himalayan to higher Himalayan Zone, and its topography is mainly hilly and mountainous with valleys and stretches of plains in between. The elevation ranges from 1000 meters to 6325 meters. High angle slopes and steep escarpments are prominent features of the area.

The entire district; is drained by Neelum river and its tributaries. The climate within the district varies greatly with altitude. The northern and northeastern part is very cold in winter and moderate in summer, while the southern parts remain cold in winter and moderate to hot in summer. May, June and July are the hottest months, while December, January and February are the coldest months.

Athmaqum, the district headquarter, is about 80 km from Muzaffarabad via Nauseri route.

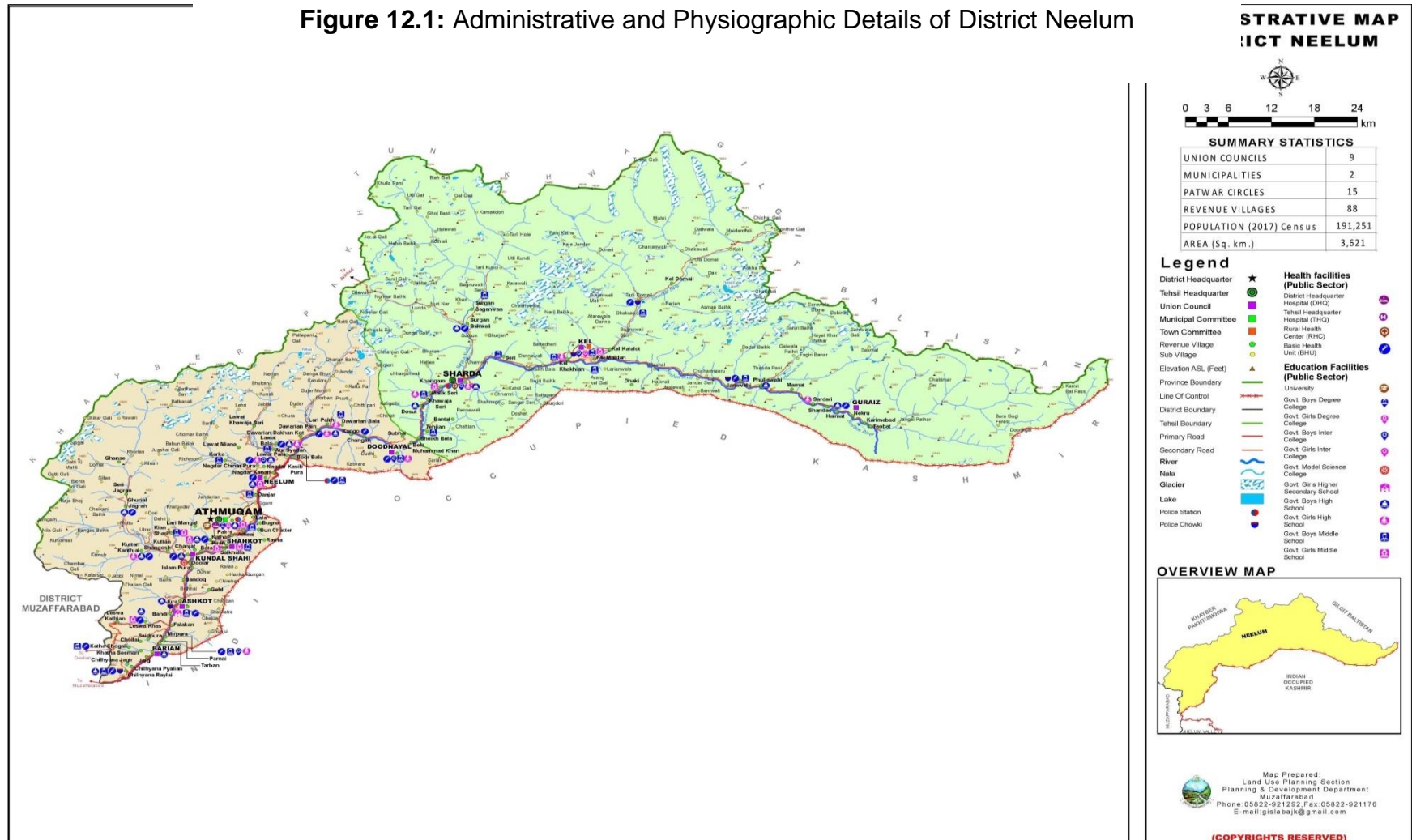
Fig. 12.1 shows the administrative and physiographic details of Neelum district.

12.3 Geology

District Neelum is situated in the north and northeastern extremity of the Hazara-Kashmir Syntaxis comprises part of the sub to higher Himalayas. The geology of the district is divided into the following:

1. The Panjal Volcanics (Basalt)
2. Igneous Intrusions (Dolerite dykes/sills)
3. Granitic Rocks

Figure 12.1: Administrative and Physiographic Details of District Neelum



4. Meta Carbonate

5. Schist and Gneiss

In district Neelum the hard rock outcrops are essentially in the form of above-mentioned lithological units. A simplified geological map of the area is presented as **Fig. 12.2**.

The Panjal Volcanics/ Agglomerates are exposed at the right bank of the Neelum river just opposite to Nauseri village and are separated from Murree Formation by a thrust fault known as Panjal Thrust (PT). It is a part of Hazara Kashmir thrust faults system. Just near the fault the Panjal Volcanics are exposed. These rocks are mainly Metabasalt and Metabasaltic Andesites i.e., these rocks are thoroughly reconstituted. Their pyroxenes are altered to form chlorite, epidote, whereas calc- plagioclase has altered to form sodic-plagioclase. The volcanic flows are overlain by Panjal Agglomerates constituting of psammite-pelitic clasts which are well cemented together, and this member is intruded by dykes/sills of dolerite.

The meta-sediments are pelitic-psammites which have been partially to fully granitized which was subsequently metamorphosed to form granite gneiss. The Nauseri granite gneiss is light grey to grey colored, porphyritic and foliated. The granite gneiss consists dominantly of quartz, microcline and two micas (muscovite and biotite). The rock is weakly foliated to gneissic. Thus, the Nauseri granite gneiss is mostly coarse grained to augen shaped within the main body and marginally becomes fine grained merging into schist garnet grade. The granite dominantly consists of microcline, plagioclase, quartz mostly strained, biotite and muscovite. The plagioclase in some cases is altered to kaolinite /sericite.

The Nauseri granite gneisses and associated meta-sediments are separated from Titwal/ Chalhana/Jura granite by a strike slip fault just one (01) km short of Chalhana.

The rocks from Chalhana/ Titwal to Luat are lithologically pelitic-psammite (Tanawal type) which is metamorphosed to garnet grade. These metamorphosed rocks are intruded by Jura granite near Mirpura and Jura and Neelum granite near Keran. Ghazanfer et al. (1983) have divided the metasediments into (a) Titwal Garnetiferous Chlorite Schist, (b) Authmaqam Biotite-Chlorite-Phyllites and Schists, (c) Kundalshahi-Nagdar Garnet-Mica Schist. These three units of schists are dominantly pelitic-psammite in nature i.e. they have lot of micaceous minerals like biotite, muscovite, chlorite etc., and very fine-grained quartz minerals. All these make the rock useless as an aggregate. The micaceous minerals make a weak bond with OPC and asphalt. The Jura and Neelum granites are very tough and at most places appear to be unaltered.

The Sharda Group of rocks starts from Luat through Doarian, Malik Seri, Sharda, Shaikh Bela and merges with migmatite near and beyond Kel. These rocks are high to very high-grade rocks starting from stauralite grade to kyanite/slimmenite grades. Lithologically these rocks are calcareous pelites/psammites and marbles. They are quite compact and strong rocks mostly. Due to metamorphism into high grade the pelitic clay minerals are changed over to biotite/muscovite and are strongly bounded with calcareous minerals to make the rock tough. At places rocks of Sharda group appears to be amphibolites (a para-amphibolite) and at other places where calcareous material acts as bounding /cementing material in small amount, the rocks are not very compact. The Sharda Group of rocks wherever they occur as para-amphibolite and migmatites being very compact and tough at most places.

The sample location map of District is presented as **Fig. 12.3**.

Geological Map of District Neelum

Figure-12.2

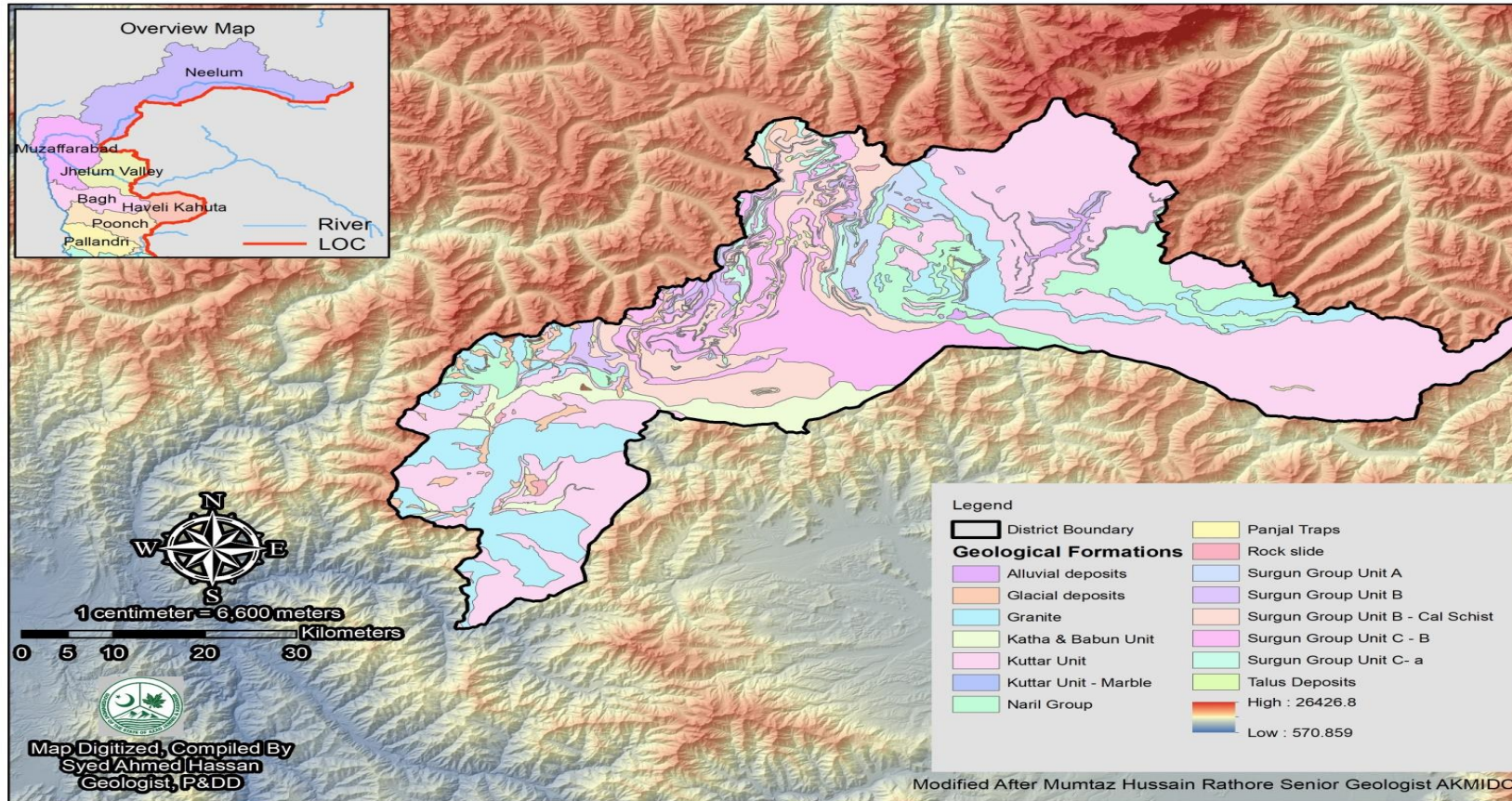


Figure 12.2: Geological Map of District Neelum

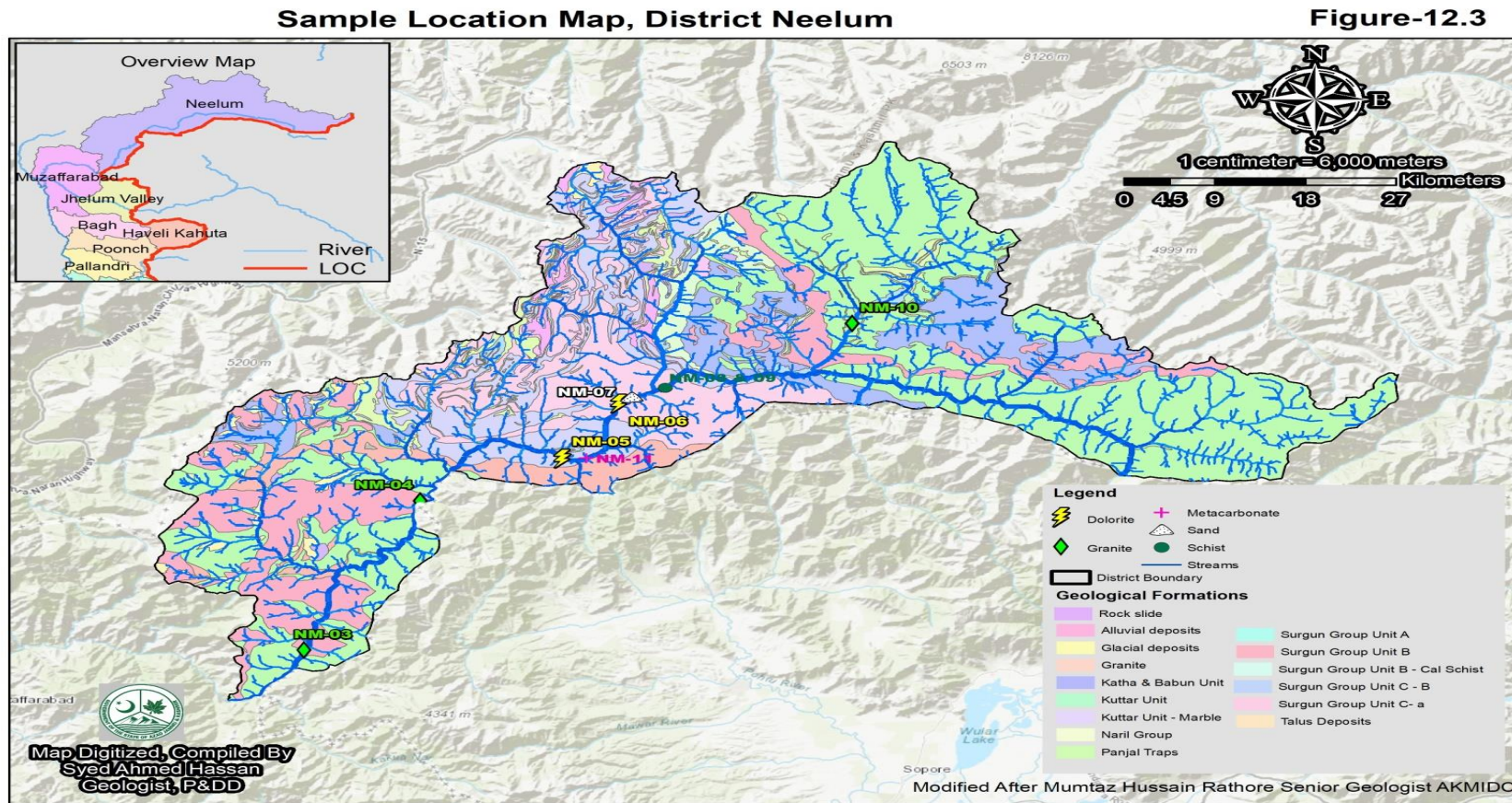


Figure 12.3: Sample Location Map of District Neelum

12.4 Construction Material Prospecting

The geologic formations exposed within the district were carefully evaluated for their potential with respect to procurement of material for construction of buildings, bridges and roads. For this purpose, the geologic formations were categorized with respect to broad engineering characteristics of various rock types.

A summary of the inferences derived from the available geological maps and site confirmation of the map is presented as below and illustrated as **Fig 12.3**:

The schists have no prospect for concrete and asphalt aggregate as well as other major construction material, whereas the granites and gneisses of the area have limited usage. The granite and granite gneiss exposed at/near Nauseri, Leswa bypass, Keran, Gumgar, Danjer and Sheikh Bela Kel to lower Domail section is recognized as having prospect (suitable) for dry stone masonry but not for hydraulic structures and concrete works. Similarly, quartz mica schist exposed in Kel to Taobutt section, Kareemabad, Nekru, Surgan, Guraiz union council etc, and at other localities of Neelum district having prospect for dry stone masonry, but the schist having dominantly pelitic-psammitic in nature are not suitable for any use in the construction.

Panjali volcanics (basalt) is also exposed in the district. This formation is recognized as having marginal prospect depending upon the strength, weathering and joint frequency of the exposure.

Igneous intrusions (dolerite, dykes/sills) having high potential for serving construction material; occur only a few places in the entire district. These rocks belong to igneous intrusions (dykes/sills) exposed in the Nauseri – Changan and Malik Seri areas.

Meta-carbonate is exposed at Dudhnial locality. This source has marginal prospect for concrete aggregate, but has high prospect for use as asphalt aggregate.

12.5 Exploration for Construction Material Sources

A comprehensive exploration program for identifying material suitable for use in construction of buildings, roads and bridges was executed in the entire district. The program was based on the local physiographic and topographic conditions, assessment of geology and material prospecting, existing sources, relevant deficiencies and State needs. The program activities included systematic identification of sources, preliminary field demarcations and assessments, comprehensive sampling, qualitative and quantitative assessments and rapid environmental examination.

These activities were conducted in accordance with the criteria and methodology stated in the previous sections. Eleven (11) sources of coarse aggregate have been identified in the district. Out of these 10 sources are for coarse aggregate and Neelum river sand for fine aggregate have various borrowing points. Construction material prospect map of these sources is shown as **Fig. 12.4**.

A summary of the exploration program for the sources is given below:

12.5.1 Nauseri and Balgran Panjali Volcanics- Meta-Basalt Source

These rocks are mainly Metabasalt and Meta-basaltic Andesites but thoroughly reconstituted. Their pyroxenes are altered to form chlorite, epidote whereas its calc-plagioclase has altered to form sodic-plagioclase. The volcanic flows are overlain by

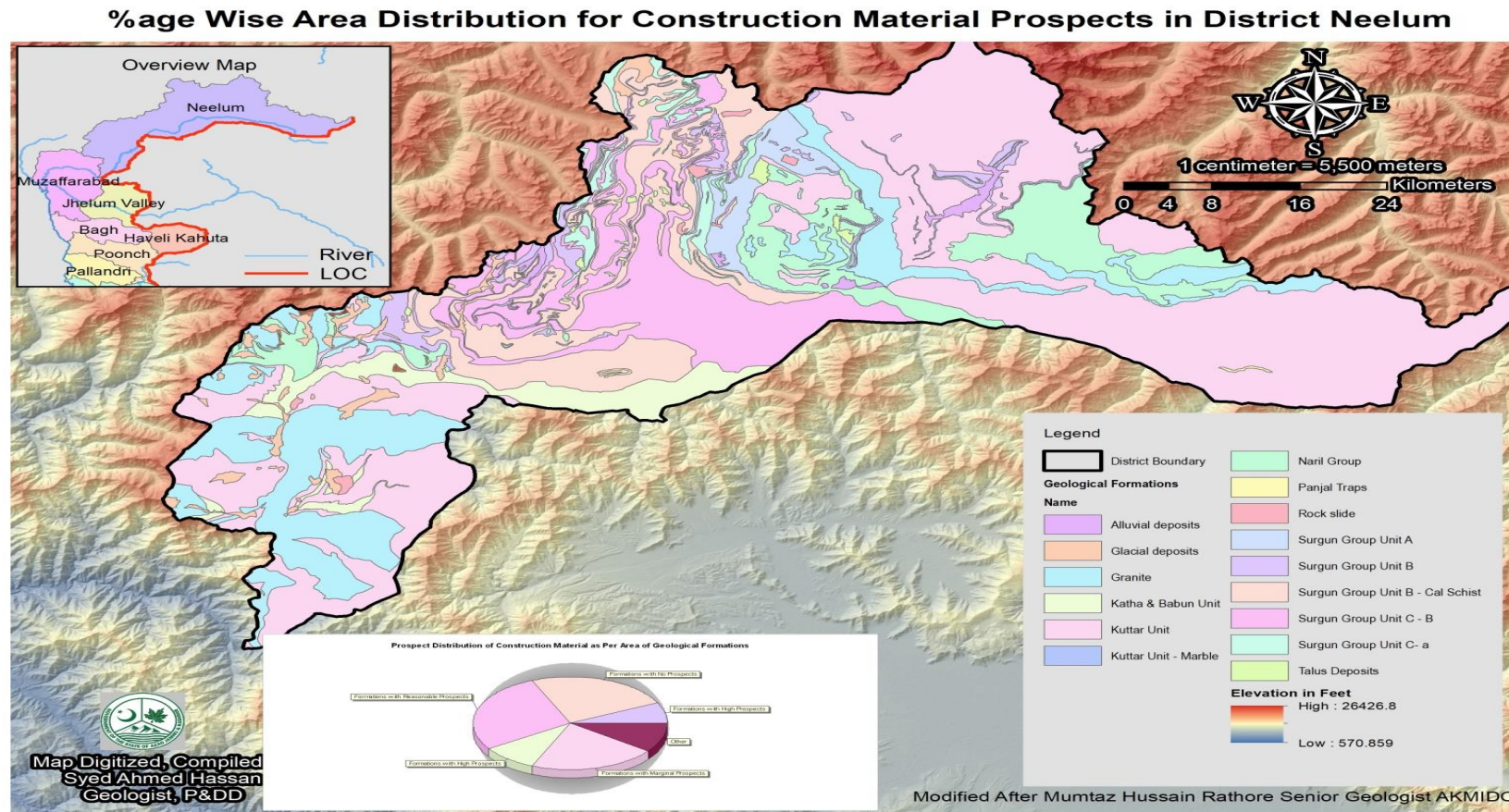


Figure-12.4

Figure 12.4: Construction Material Prospects of District Neelum

Panjal Agglomerates constituting of psammite-pelitic clasts which are well cemented together and this member is intruded by dykes / sills of dolerite. The reserve of the source is approximately more than 9.063 million cubic meters.

The quarry area extends on both side of the riverbank. The quarry area has been investigated through topographic and geological mapping, sampling and testing of rock samples. The investigated quarry area is occupied by basaltic rock mass along with some local mineralogical variation.

The rock is well exposed on both banks of the river and at Balgran village road side in the form of clean, blocky and massive rock greenish grey to dark grey outcrop of metabasalt. In the quarry, area is dominantly occupied by meta-basaltic rock having dark greenish grey to dark grey colored. However, in the proposed quarry area a few shear zones may be encountered.

Samples were collected from the sources. The mineralogical and physical testing was carried out.

The source, however, invariably contains authogenic chert associated with the pillow lavas. The chert seems are obvious in the deposits.

12.5.2 Nauseri Igneous Intrusions (Dolerite Dykes) Source

Igneous intrusions (dolerite dykes/sills) are located in the Nauseri–Changan and Malik Seri localities. These rock units have higher potential for serving as construction material. Stratigraphically, these rocks belong to later igneous intrusions (dykes/sills) in the host rocks. The reserve of the source is approximately more than 1.44 million cubic meters.

Sampling for mineralogical, physical and engineering testing were carried out from these sources for evaluation.

12.5.3 Neelum Valley Granites and Granite Gneisses

The granites / meta-sediments are pelitic-psammites, which have been partially to fully granitized and subsequently metamorphosed to form granite gneiss. The Nauseri granite gneiss is light grey to grey colored, porphyritic and foliated. The granite gneiss consists dominantly of quartz, microcline and two micas (muscovite and biotite). The rock is weakly foliated to gneissic. Thus, the Nauseri granite gneiss is mostly coarse grained to augen shaped within the main body and marginally becomes fine grained merging into schist garnet grade. The granite dominantly consists of microcline, plagioclase, quartz mostly strained, biotite and muscovite. The plagioclase in some cases is altered to kaolinite /sericite.

Sample from various locations of this source have been collected.

- Jura Granite
- Neelum Granite

12.5.4 Dudhnial and Balgran Meta Carbonate

Meta-carbonate is exposed at Dudhnial locality approximately 24 km from the Athmaqum and the rock is also well exposed at Balgran village, road side in the form of clean, blocky and massive light grey to dark grey outcrop. This source has marginal prospect as concrete aggregate but high prospect for asphalt aggregate.

The collective deposit has been evaluated through geological mapping and sampling of the outcrop. The collective reserve of the source is approximately more than 4.0 million cubic meters.

10.5.5 Malik Seri Dolerite

The Malik Seri dolerite belongs to Sharda Group and exposed about 3 km short of Sharda along the Neelum valley road in the form a lenticular dyke having a maximum of about 500 m thick along the road. The reserve of the source is approximately more than 3.5 million cubic meters.

10.5.6 Changan Meta-Dolerite

Changan meta-dolerite belongs to Sharda Group and exposed along the road near Changan about 5 km short of Dudhnial village. The dolerite is exposed as dyke of about 100 m thickness in the surrounding metamorphic bedrock mainly schist and marbles. The reserve of the source is approximately more than 1.776 million cubic meters.

10.5.7 Schists and Gneisses

Schist and Gneiss occupies a major part of the bedrock of the district. This area composed of metamorphic complex quartz mica schist, mica schist, graphitic schist, calc-schist, ortho and para gneisses. These units have no potential with respect to concrete and asphalt aggregate.

12.6 Source Digests

Detailed information pertinent to any individual source is put together in the form of "Source Digest". The information for each source relates to (a) location and accessibility, (b) physiographic and geologic conditions, (c) environmental appraisal, (d) extent of investigations conducted, (e) summary results of investigations, (f) principal evaluations, and (g) recommendations. The source digests are organized alpha-numerically for efficient tracking of information.

The information provided in the respective source digests form basis for the analyses and procurement plans.

12.7 Suitability of the Investigated Sources

A careful evaluation of the 22 investigated sources was conducted to establish their suitability in broad terms as construction material. Thirteen (13) sources have been selected for further study. Remaining identified sources were disregarded in the very early stages of study, as these sources belong to schist's and gneisses. The evaluation was made in strict compliance to the criteria stated in Chapter 4.

A summary of the evaluation results is given below:

- 1 Seven (07) rock sources have been rated as suitable for quarrying coarse aggregate for producing (a) concrete of varying strength, (b) asphalt road works, and (c) base/ sub-base road elements. The rocks comprising these sources include meta-basalt, dolerite and meta-carbonate. These sources are also suitable for quarrying stone for masonry works.
- 2 Meta-basalt and Meta-carbonate have been rated as suitable for borrowing coarse aggregate for producing (a) concrete of low-strength (b) base/ sub-base road elements. The Meta-carbonate have been rated as suitable for borrowing coarse aggregate for producing (a) asphalt road works (b) base/ sub-base road elements.

- 3 Detailed comments concerning the suitability of each of the explored sources are made in the respective "Source Digest".
- 4 Neelum river sand sources have been rated as suitable for low-strength concrete production. These sources are located near Chhalpani, Kharigam, Sharda, Sheikh Bela and Kel.
- 5 The local limited exposures of meta-sediments, basalt/metabasalt (Greenstone), meta-carbonate, dolerite, granite, gneiss, schist and river/nullahbed gravel deposits having characteristics similar to the identified sources, the recommendations presented in **Table 12.1** for this material shall also prevail. Such material may encounter during road cutting and project excavations.
- 6 The schist has no prospect for concrete and asphalt aggregate as well as other major construction material, whereas the granites and gneisses of the area have limited usage. The granite and granite gneisses exposed at/near Nauseri, Leswa bypass, Keran, Jumgar, Danjer, Guraiz union council and Sheikh Bela Kel to lower Domail section is recognized as having prospect (suitable) for dry stone masonry but not for hydraulic structures and concrete works. Similarly, quartz mica schist exposed at Taobutt, Kareemabad, Nekru etc and other localities of Neelum district having prospect for dry stone masonry, but the schist having dominantly pelitic-psammetic in nature are not suitable.

12.8 Recommended Uses of Suitable Sources

The sources declared suitable have varying petrographic, physical and engineering characteristics. A cautious evaluation of the characteristics of each source was carried out to identify its appropriate uses as construction material in light of the Composite Schedule of Rates for AJ&K.

Based on this evaluation, the recommended uses of all the sources for various construction types are indicated in Table.12.1. Necessary precautions for quarrying and borrowing from these sources are given in respective "Source Digest".

CONSTRUCTION MATERIAL SOURCES IN AND AROUND AZAD JAMMU & KASHMIR

TABLE 12.1

Recommended Uses of Various Material Sources in District Neelum

QUARRY NAME	Source Code	TYPE OF CONSTRUCTION																														
		STRUCTURES WITH GREATER LIFE RISK												STRUCTURES WITH LESS LIFE RISK						ROADS												
		Private Houses and Public Buildings (Max. Two Storey Schools, BHU, etc.)						Major Public Buildings (Colleges, Hospitals and Bridges etc.)						Causeways		Culverts		Concrete		Masonry walls		Inter-district Roads		Intra-district Roads		Community Roads						
		Stone	Non-Load Bearing Concrete Blocks	Load Bearing Concrete Blocks (2000 psi)	Lean Concrete	Concrete upto 2000 psi	Concrete 2000-4000 psi*	Stones	Non-Load Bearing Concrete Blocks	Load Bearing Concrete Blocks (2000 psi)	Lean Concrete	Concrete upto 2000 psi	Concrete 2000-4000 psi*	High Strength Concrete	Pre-stressed Concrete	Stone	Lean Concrete	Concrete (Upto 3000 psi)*	Stone	Lean Concrete	Reinforced Concrete (3000psi)*	Lean Concrete	Concrete (Upto 3000 psi)*	Stones	Lean Concrete	Concrete (3000 psi)*	Base / Sub Base	Asphalt Layer	Sub Base / Soling	Asphalt Layer	Soling	Asphalt Layer
Nauseri Volcanics (Basalt)	NM-01	✓	✓	✓	✓	✓	×	✓	✓	✓	✓	×	×	×	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	×	✓	×	✓	×	✓	×
Nauseri Dolerite	NM-02	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	▲	▲	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Islampur-Jura Granite Sandok	NM-03	✓	✓	×	×	×	×	✓	✓	×	×	×	×	×	✓	✓	×	✓	✓	×	✓	×	✓	✓	×	×	×	×	×	✓	×	
Neelum Granite Keran	NM-04	✓	✓	×	×	×	×	✓	✓	×	×	×	×	×	✓	✓	×	✓	✓	×	✓	×	✓	✓	×	×	×	×	×	✓	×	
Dudhnial Meta Carbonates	NM-05	✓	✓	✓	✓	✓	×	✓	✓	✓	✓	×	×	×	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Malik Seri Dolerite Kharigam	NM-06	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	▲	▲	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Sharda-Shaikh Bela Schist	NM-08	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
Kel-Shaikh Bela Schist	NM-9	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
Dhokran Gneiss Kel	NM-10	✓	✓	×	✓	✓	×	✓	✓	×	✓	×	×	×	✓	✓	×	✓	✓	×	✓	×	✓	✓	×	✓	×	✓	×	×	×	×
Changan Meta Dolerite	NM-11	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	▲	▲	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Suitable ✓

Project Specific Studies including Mix Design

▲ Not Suitable ×

The recommendations are based on the presumption that the available cement type in the State is Ordinary Portland Cement.

Requires Mix Design in Recommended Case *

NOTES:

- Some sources contain invariably varied proportion of reactive constituents. The aggregate may or may not be ASR susceptible depending on the percentage of reactive constituents. However, it is recommended to use the such aggregate safely in concrete when the total alkalis from all sources do not increase the threshold value of 2.5 kg per cubic meter of concrete.
- Material suitability of very high strength and prestressed concrete shall be established on the basis of actual concrete mix design
- The source contains high proportion of strained quartz. The recommendation at Sr. No.1 also applicable to this source.
- The sources can be used for concrete with the following options if declared non recommended on the basis of ASR susceptibility, however this shall require source specific study.
 - Low Alkali Cement (Alkalis as Na₂O less than 0.4%)
 - Slag Cement or Pozzolanic Cement
 - Using Slag, Fly Ash or Silica Fume as Partial Replacement with the OPC
- The reactive aggregate are being recommended for few concrete classes keeping in view that the cement content in such concrete is quite low. The total alkalis in concrete will not increase the threshold level of 2.5kg/ cu.m.

The local limited exposures of granites, metacarbonates, metabasalt, and volcanics if encounter during road cutting and project excavation and having properties similar to the identified sandstone sources, the above recommendations shall also prevail for this material.

CHAPTER 13

CONSTRUCTION MATERIAL SOURCES STUDY OF DISTRICT POONCH

13.1 General

Districts Poonch and Sudhnuti are two central districts of the State. By virtue of their geologic setup these two districts are similar to the southern districts and are dominated by the sedimentary bedrock sequence mostly soft and friable in nature. In the light of experience gained from the southern districts study, a comprehensive construction material study of district Poonch was conducted that included assessment of area potential, identification of all existing and potential sources, qualitative evaluation, and accordingly determining their suitability for use as construction material for buildings, roads and bridges.

This chapter provides details of explorations, evaluations, and suitability assessments of all source's studies in district Poonch. The adequacy of construction material on district level is also discussed, which would serve as a realistic basis for preparing material procurement plan for the district.

13.2 Administrative Setup and Physiography

District Poonch extends over an area of 855 km², which hosts a population of about 411,035 persons (1998 Census- 1999 Projection). It shares inter-district boundaries with Kotli district in south and with Bagh in north. In the west, it is bounded by Punjab (Pakistan). In the east it is bordered by "Line of Control" with India.

The district comprises four tehsils, namely Rawalakot, Hajira, Thorar and Abbaspur. Rawalakot city is the districts headquarter. The other tehsil headquarters are Hajira, Thorar and Abbaspur. The main towns include Trarkhal, Baluch, and Mong. All these towns are well connected through metaled roads.

The district forms part of Lesser Himalayan Zone, and its topography is mainly low to moderate high with valleys in between. Rawalakot the districts headquarter is situated in the heart of district Poonch. The altitude of this valley is 1615 meters. The main river of the district is Poonch, which feeds the Mangla reservoir. The entire district; is drained by Poonch river and its tributaries like Rangar nullah, Goi nullah, Shujaabad nullah and other minor tributaries.

The climate within the district varies with altitude. The northern and northwestern part is very cold in winters and moderate in summers, while the southern remains cold in winters and moderate to hot in summers. May, June and July are the hottest months, while December, January and February are the coldest months.

The maximum and minimum temperatures in the month of January vary between -10°C and 5°C, while the same in the month of June vary between 40°C and 15°C respectively. The annual precipitation rate is about 1500 millimeters.

Rawalakot city is located at a distance of about 120 km from Islamabad via Goi nullah road. Besides inter-district roads, there exist nearly 1867 km long link roads constructed by the local government.

Fig. 13.1 shows the administrative and physiographic details of district Poonch.

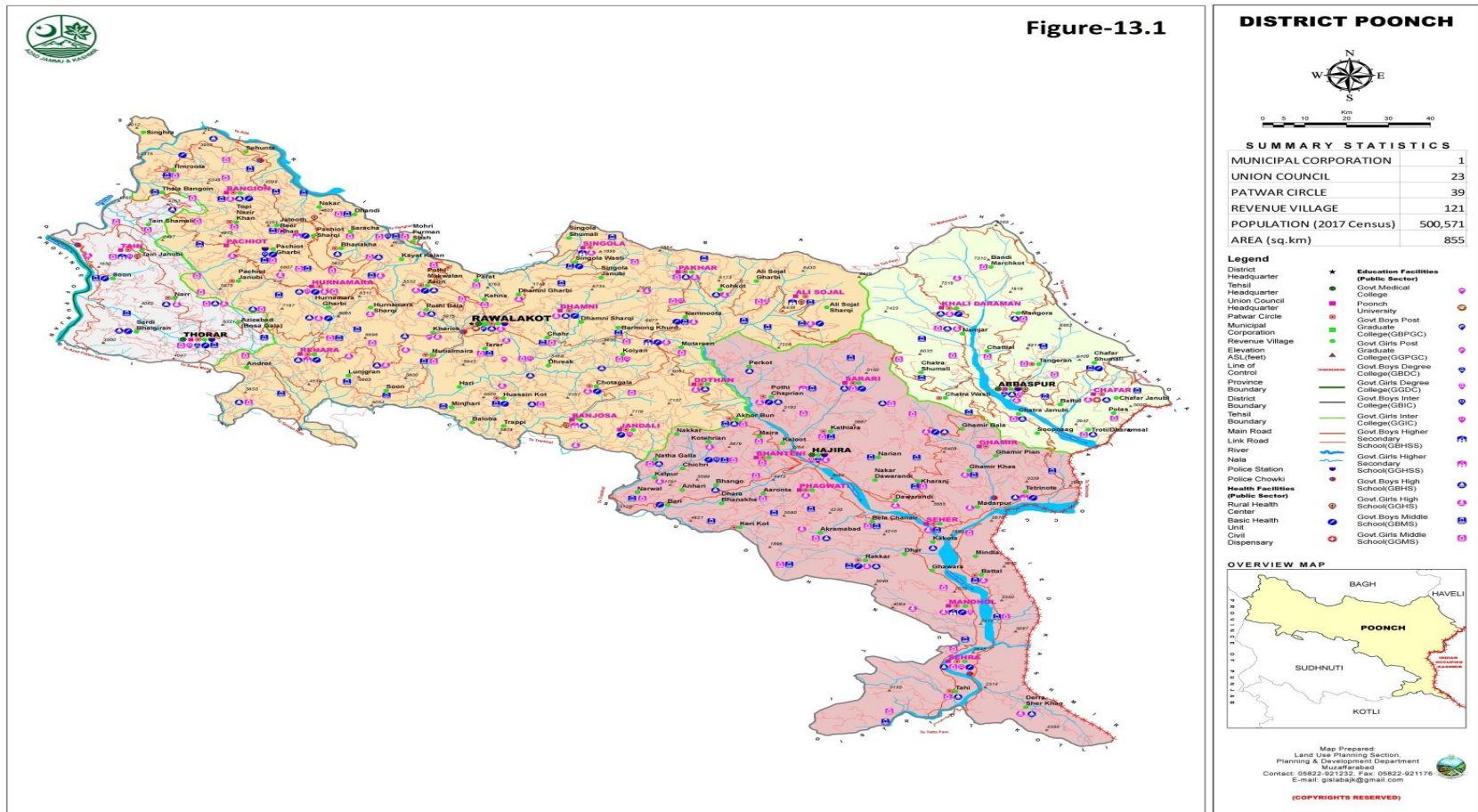


Figure 13.1: Administrative and Physiographic Details of District Poonch

13.3 Geology

District Poonch is situated in the western axial zone of Hazara-Kashmir syntaxis, which is the part of the Lesser Himalayas. The syntaxis exhibits two major thrusts, including Panjal Thrust and Main Boundary Thrust (MBT). Himalayan Frontal Thrust is the main tectonic feature of the area. The Himalayan Frontal Thrust runs in the north/northwest to south/southeast.

The district mostly comprising molassic rocks belonging to the Murree Formation. The molassic rocks comprise siltstone; sandstone and shale of early Miocene age are mostly exposed in Rawalakot, Hajira, Thorar and Abbaspur tehsils.

In addition to the above, the areas forming major valley floors are mostly covered with thick terrace deposits comprising gravel and boulders embedded in clayey silt matrix. The hill slopes are at places covered with colluviums of varying thicknesses.

Murree Formation also contains sandstone beds which are fine to medium grained and well cemented. The nullah bed deposits derived from the catchment having this sandstone contain abundant gravel and boulders.

A simplified geological map is presented as **Fig. 13.2**.

13.4 Construction Material Prospecting

The geologic formations exposed within the district were carefully evaluated for their potential with respect to procurement of material for construction of buildings, bridges and roads. For this purpose, the geologic formations were categorized with respect to the broad engineering characteristics of various rock types illustrated in **Fig. 13.3**.

The geologic formations exposed in 20% of the area have no prospect for concrete and asphalt aggregate as well as other major construction material required. These formations include Early Siwalik Group (Chinji Formation).

Murree Formation covers almost 80% of the total district area. These formations comprise alternating beds of siltstone, shale and sandstone. The siltstone and shale beds form more than two third of the geologic formation, however, they have no prospect of using as construction material. On the other hand, the sandstone beds are recognized as having marginal potential depending upon the hardness and joint frequency of the individual beds.

Area covered with Quaternary deposits comprising mainly flood plain, terrace deposits and silt etc. Amongst these, the riverbed/nullah bed and few terraces have also marginal prospects for construction material depending upon the rocks exposed in the stream catchments.

13.5 Exploration for Construction Material Sources

A comprehensive exploration program for identifying material suitable for use in construction of buildings, roads and bridges was executed in the entire district. The program was based on the local physiographic conditions, assessment of geology and material prospecting, existing sources, relevant deficiencies and State needs. The program activities included systematic identification of sources, preliminary field demarcations and assessments, comprehensive sampling, qualitative and quantitative

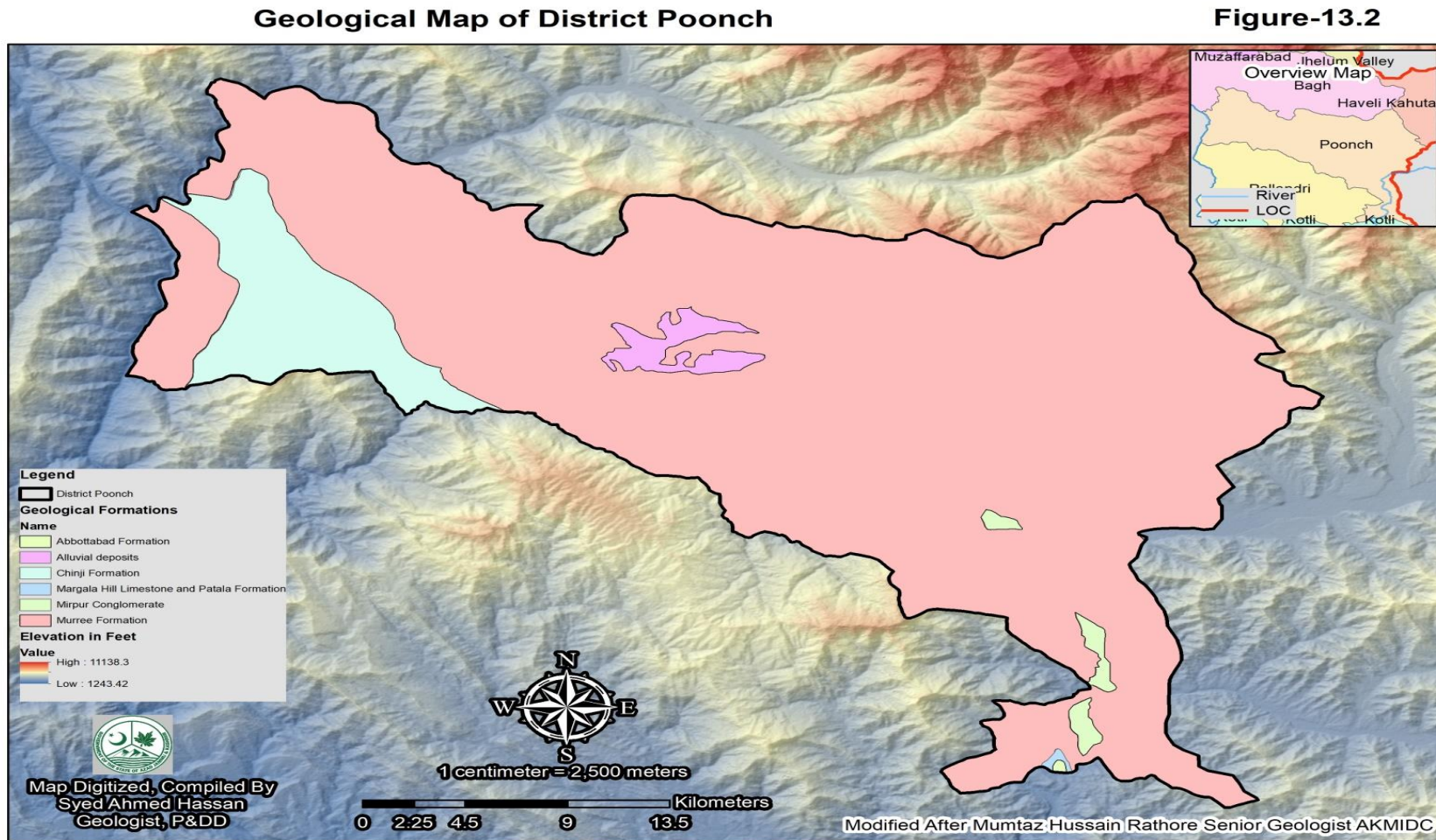


Figure 13.2: Geological Map of District Poonch

%age Ara Distribution of Geological Formations w.r.t Construction Material Prospect, District Poonch **Figure-13.3**

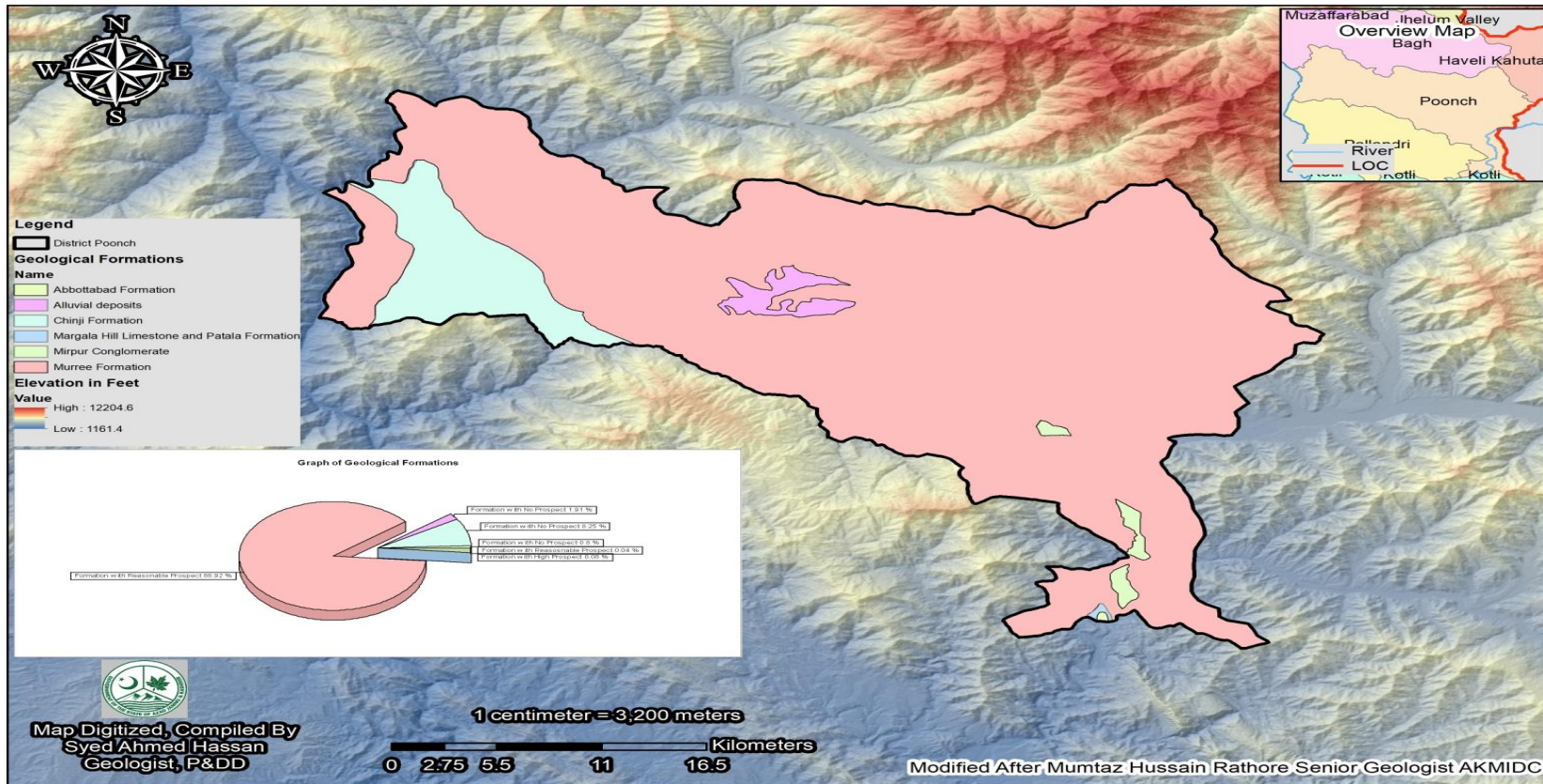


Figure 13.3: Construction Material Prospects of District Kotli

assessments and rapid environmental examination. These activities were conducted in accordance with the criteria and methodology stated in the previous sections. A summary of the exploration program is given below:

Five (05) sources with thirteen (13) quarrying points were identified and studied within the entire district. All sources were evaluated as potentially marginal sources for coarse aggregate and base/sub-base material.

Rapid environmental examination of all the sources was conducted in the very beginning of the exploration. Moreover, a comprehensive review of the existing quarrying techniques and material procurement procedures were carried out.

Hand samples were collected from these sources, out of which representative samples were analyzed through petrographic microscope after preparing thin sections. Set of petrographic analysis results for each source was evaluated with respect to perspective usages of the material.

Bulk samples were collected from these sources, out of which representative samples were analyzed for physical properties at the Central material Testing Laboratory, WAPDA. The testing program was prepared considering the expected uses of the material and laboratory test results were accordingly evaluated.

All relevant technical details relevant to each of the explored sources are recorded in the form of source digests and presented in this report.

The gravel and hard rock material of the district, having potential can be categorized in the following major sources:

- a- Sandstone of Murree Formation
- b- Nullah/River bed material

The sandstone of Murree Formation comprises the following sections. Samples have been collected from the following locations.

- PN-1 Arja – Dalkot Section Sandstone
- PN-2 Ghohi Nullah-Rawalakot Section Sandstone
- PN-3 Rawalakot- Khai Gala-Hajira Section Sandstone
- PN-4 Hajira-Abbaspur-Haveli Nullah/River bed material
- PN-5 Hajira-Abbaspur-Haveli Section Sandstone

Samples have been collected from various locations of the sections.

Murree Formation is an important geological feature of the southern Kashmir in district Poonch. Approximately 80% of the exposed rock consists of Murree Formation. The sandstone of Murree Formation exposed in the district is greenish grey to grey color.

There is no crushing activity on rock outcrops for aggregate production. However, crushers are already installed at PN-4 Hajira-Abbaspur-Haveli road section in Rangar nullah and Poonch riverbed material. The locations of these sources are shown in **Fig. 13.4**.

13.6 Source Digests

Detailed information pertinent to individual source is put together in the form of "Source Digest". The information for each source relates to (a) location and accessibility, (b)

Sample Location Map of District Poonch

Figure-13.4

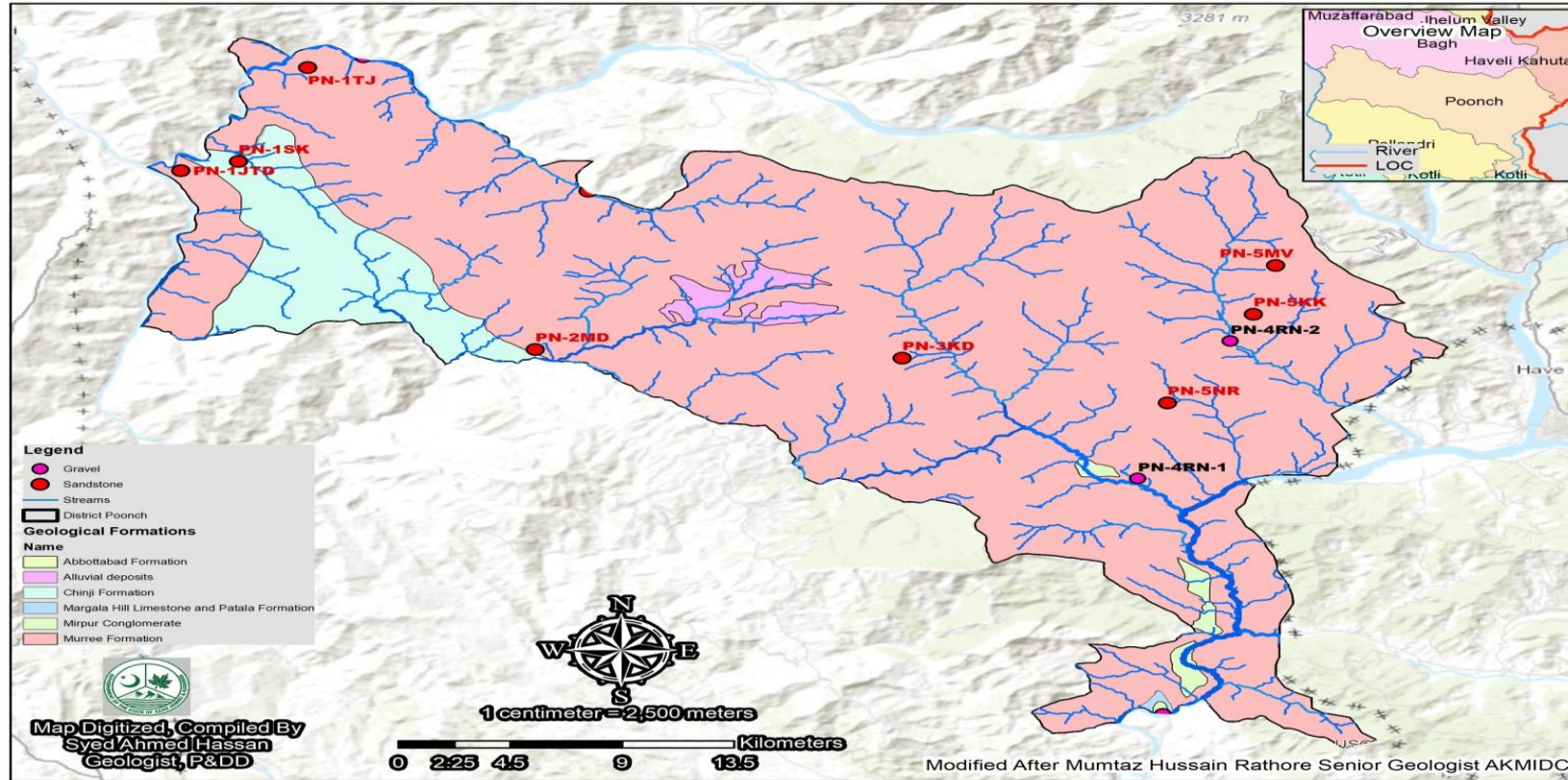


Figure 13.4: Sample Location Map of District Poonch

physiographic and geologic conditions, (c) environmental appraisal, (d) extent of investigations conducted, (e) summary results of investigations, (f) principal evaluations, and (g) recommendations. The source digests are organized alpha-numerically for efficient tracking of information.

The information provided in the respective source digests form basis for the analyses and procurement plans.

13.7 Suitability of the Investigated Sources

A careful evaluation of the five (05) investigated sources was conducted to establish their suitability in broad terms as construction material. The evaluation was made in strict compliance to the criteria stated in Chapter 4. A summary of the evaluation results is given below:

- 1 All rock sources have been rated as suitable for borrowing coarse aggregate for producing (a) concrete of low-strength (b) base/ sub-base road elements.
- 2 The nullah/river and terrace gravel sources have been rated as suitable for borrowing coarse aggregate for producing (a) concrete of low-strength (b) base/ sub-base road elements.
- 3 All rock sandstone sources of Murree Formation have been rated as suitable for quarrying stone for various masonry works and soling material for road works.

Detailed comments concerning about the suitability of each explored sources is made in the respective "Source Digest".

13.8 Recommended Uses of Suitable Sources

The sources declared suitable have varying petrographic, physical and engineering characteristics. A cautious evaluation of the characteristics of each source was carried out to identify its appropriate uses as construction material in light of the Composite Schedule of Rates for AJ&K.

Based on this evaluation, the recommended uses of all the sources for various construction types are indicated in **Table.13.1**. Necessary precautions for quarrying and borrowing from these sources are given in respective "Source Digest" provided separately. Considering the difficult topographic conditions of the area for transport the material downhill, construction of chutes/conveyor belt system is recommended for quarry development.

**CONSTRUCTION MATERIAL SOURCES IN AND AROUND AZAD JAMMU & KASHMIR
TABLE 13.1**

Recommended Uses of Various Material Sources in District Poonch

QUARRY NAME	Source Code	TYPE OF CONSTRUCTION																														
		STRUCTURES WITH GREATER LIFE RISK												STRUCTURES WITH LESS LIFE RISK						ROADS												
		Private Houses and Public Buildings (Schools, BHU, etc. of max. 2 storeys)						Major Public Buildings (Colleges, Hospitals and Bridges etc.)						Causeways		Culverts		Concrete		Masonry walls		Inter-district Roads		Intra-district Roads		Community Roads						
		Stone	Non-Load Bearing Concrete Blocks	Load Bearing Concrete Blocks (2000 psi)	Lean Concrete	Concrete upto 2000 psi	Concrete 2000-4000 psi *	Stones	Non-Load Bearing Concrete Blocks	Load Bearing Concrete Blocks (2000 psi)	Lean Concrete	Concrete upto 2000 psi	Concrete 2000-4000 psi *	High Strength Concrete	Pre-stressed Concrete	Stone	Lean Concrete	Concrete (Upto 3000 psi)*	Stone	Lean Concrete	Reinforced Concrete (3000psi) *	Lean Concrete	Concrete (Upto 3000 psi)*	Stones	Lean Concrete	Concrete (3000 psi)	Base / Sub Base	Asphalt Layer	Sub Base / Soling	Asphalt Layer	Soling	Asphalt Layer
Arja - Dalkot Section (Outcrop)	PN-1	✓	✓	✓	✓	✓	x	✓	✓	✓	✓	✓	x	x	x	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	x	✓	x	✓	x
Ghothi Nullah-Rawalakot (Outcrop)	PN-2	✓	✓	✓	✓	✓	x	✓	✓	✓	✓	✓	x	x	x	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	x	✓	x	✓	x
Rawalakot- Khai Gala-Hajira (Outcrop)	PN-3	✓	✓	✓	✓	✓	x	✓	✓	✓	✓	✓	x	x	x	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	x	✓	x	✓	x	
Hajira-Abbaspur-Havali (River Bed)	PN-4	x	✓	✓	✓	✓	x	x	✓	✓	✓	✓	x	x	x	x	✓	✓	✓	✓	✓	✓	✓	✓	x	✓	✓	✓	x	✓	x	
Hajira-Abbaspur-Havali (Outcrop)	PN-5	✓	✓	✓	✓	✓	x	✓	✓	✓	✓	✓	x	x	x	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	x	✓	x	✓	x	
Jaboti-Ali Sojal Section(Outcrop) Shaheed Gala	PN-6	✓	✓	✓	✓	✓	x	✓	✓	✓	✓	✓	x	x	x	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	x	✓	x	✓	x	
Jaboti-Tolipeer Section(Outcrop)	PN-7	✓	✓	✓	✓	✓	x	✓	✓	✓	✓	✓	x	x	x	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	x	✓	x	✓	x	
Suitable ✓		Project Specific Studies including Mix Design												Not Suitable x						Requires Mix Design in Recommended Case *												

The recommendations are based on the presumption that the available cement type in the State is Ordinary Portland Cement.

NOTES:

- The sources can be used for concrete with the following options if declared non recommended on the basis of ASR susceptibility, however this require source specific study.
 - Low Alkali Cement (Alkali as Na₂O less than 0.4%)
 - Slag Cement or Pozzolanic Cement
 - Using Slag, Fly ash or Silica Fume as Partial Replacement with the OPC
- The reactive aggregate are being recommended for few concrete classes keeping in view that the cement content in such concrete is quite low. The total alkalis in concrete will not increase the threshold of 2.5kg/ cu.m.
- More than 10" boulder size will be used to get angular soling stone up to 6", if required.

CHAPTER 14

CONSTRUCTION MATERIAL SOURCES STUDY OF DISTRICT SUDHNUTI

14.1 General

Like all other districts, a comprehensive construction material study of district Sudhnuti was also conducted in accordance with the Terms of Reference, the work methodology and the experience gained during the entire study period. This district is different in respect that its geologic nature makes it least productive in terms of construction material availability. The study thus included assessment of area potential, identification of all existing and potential sources, qualitative evaluation, and accordingly determining their suitability for use as construction material for buildings, roads and bridges.

This chapter provides details of explorations, evaluations, and suitability assessments of all source's studies in district Sudhnuti. The adequacy of construction material on district level is also discussed which serves as a realistic basis for preparing material procurement would plan for the district.

14.2 Administrative Setup and Physiography

District Sudhnuti extends over an area of 569 km², which hosts a population of about 334,091 persons (1998 Census- 1999 Projection). The district is bounded by Poonch district to the north and northeast; district Kotli in south and Punjab in the west.

The district comprises Palandri tehsil. Palandri city is the districts headquarter. All the major towns are well connected through metaled roads.

The district forms part of Lesser Himalayan Zone, and its topography is mainly low to moderate high with valleys in between. Palandri is at an elevation of 1372 meters. The climate within the district varies with altitude. The northern and northwestern part is very cold in winter and moderate in summer, while the southern remains cold in winter and moderate to hot in summer. May, June and July are the hottest months, while December, January and February are the coldest months.

The maximum and minimum temperature in the month of January vary between -5°C and 10°C, while the same in the month of June vary between 40°C and 15°C respectively. The annual precipitation rate is about 1500 millimeters.

Palandri city is located at a distance of about 100 km from Islamabad via Azad Pattan road. Besides inter-district roads, there exist nearly 747 km long link roads constructed by the local government. **Fig.14.1.** shows the administrative and physiographic details of Sudhnuti district.

14.3 Geology

The 70-80% part of district Sudhnuti comprises of Siwalik Group is the part of Sub-Himalayan range dominantly occupies low relief hills of fresh water deposited rocks of Siwalik Group including Early Siwalik (Chinji Formation) and middle Siwaliks (Nagri & Dhok Pathan Formations). The Siwaliks were deposited in geo-syncline in front of rising mountains by the streams rejuvenated by this major uplift initiated in the Miocene epoch. That geosyncline was more northerly orientated than of the Indo-Ganges in which now-a-days the sediments are being deposited. The 2nd orogenic phase discontinued the course of streams followed by a major depositional event which results the deposition of Soan Formation of the Siwalik Group. The 20-30% part of district Sudhnuti comprises molassic

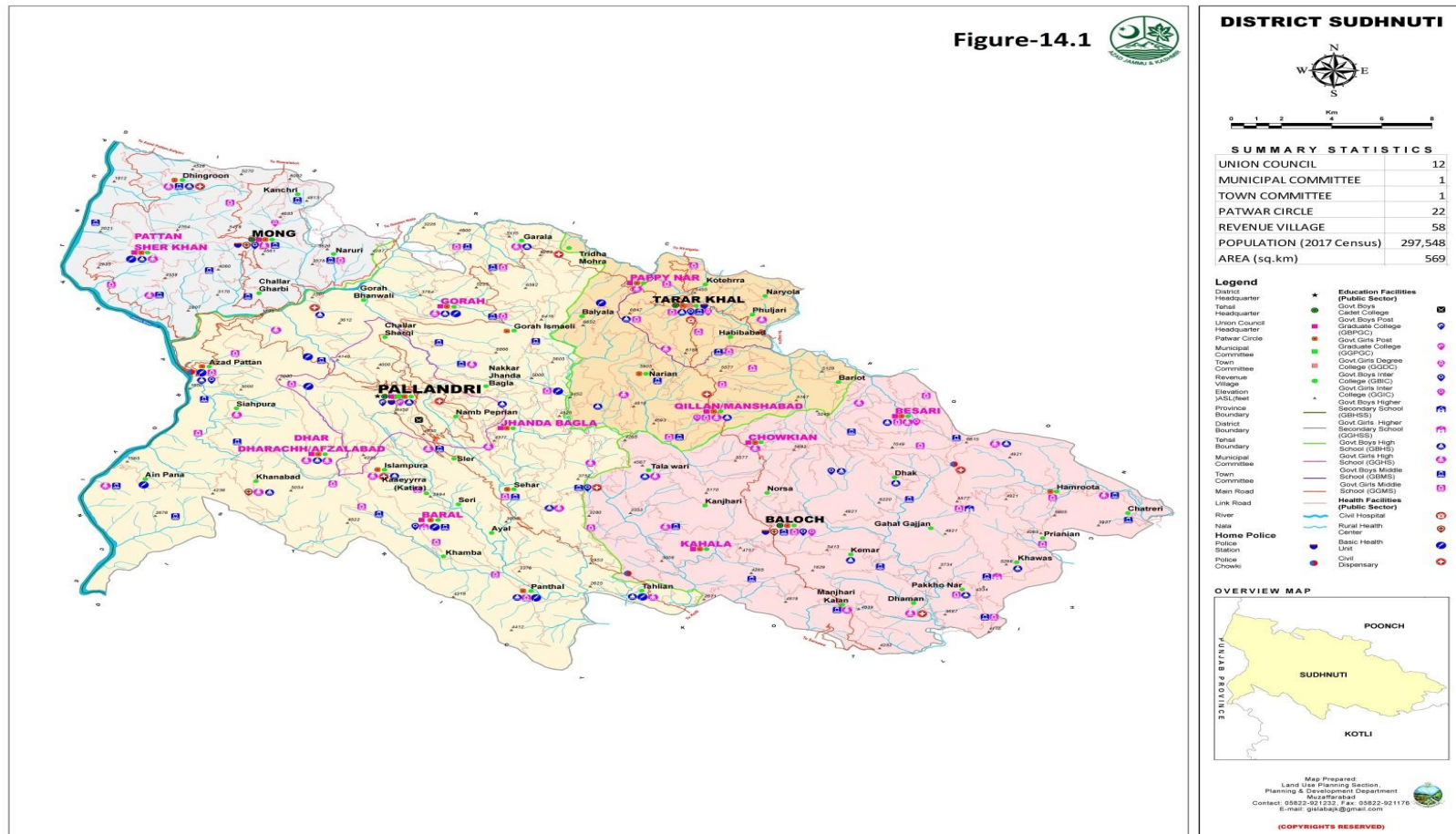


Figure 14.1: Administrative and Physiographic Details of District Sudhnuti

rocks belonging to the Murree Formation. The molassic rocks comprise siltstone, sandstone and shale of early Miocene age.

Lithologically, the Siwaliks consists of intercalated beds of sandstone, siltstone and clay in the lower and middle part; in the upper parts, conformable gravel beds also occur. Some of the beds are over 100 feet in thickness and can be traced individually over a long distance. Since these deposits are fresh water origin, most of the thinner beds are lenticular and pinch out rapidly, there can be considerable lateral variation. The sandstone beds are fine to medium grained and 90% of the beds are so poorly cemented that these can be crumbled under the fingers. The remaining 10% form hard lenticular masses/ribs of better cemented sandstone. Most of the outcrops are covered under thick vegetation and forests.

History of nomenclature of Siwaliks indicates that the term "Siwalik" was used by Medicott (1864) for upper part of sub Himalayan system of Siwalik and Shimla hills of India, latter Oldham (1886) and Holland et al (1913) used the term "Siwaliks series" and "Siwaliks system". The Stratigraphic Committee of Pakistan following Danilchick and Shah(1967) established the Siwaliks group for Siwaliks series system comprising the following Formations in descending order ; Soan Formation (Tatrot and Pinjor), Dhok Pathan Formation, Nagri Formation and Chinji Formation. The name Siwalik Group is herein extended to similar suite of rocks in Lower Indus Basin, including the Manchhar of Vredenburg (1906), the Manchhar and Sibi and Urak groups (excluding their lower parts) of Hunting Survey Corporation (1961).

No type locality has been designated for the group so far. Type localities of the component formations are, however, given in their respective descriptions. According to Danilchick and Shah (1967), the group is mainly composed of alternating beds of Sandstone and Argillaceous material. These were deposited in the belt between the Sub-Himalayan hills and Arabian Sea, where a vast pile of fresh water sediments had started accumulating since the Miocene epoch (Pascoe, 1963). The group as whole consists of sediments of clastics origin of molasse type. The lithology typically consists red clay with subordinate sandstone (Chinji Formation) at the base, which is overlain by thick sandstone with minor clay (i.e. Nagri Formation). This is succeeded by a cyclic alternation of clay and sandstone (Dhok Pathan Formation), followed by a conglomerate sandstone clay sequence (Soan Formation) in the upper part.

The group is widely distributed in Indus basin, part of the Calcareous zone of Northern Axial belt and is the Waziristan Parachinar areas. This belt of Siwaliks development continues (extends) in the east to Burma. The group is thousands of meters thick. The thickness of individual formations is highly variable and is given at relevant places. The lower contact of the group is conformable in most of the localities. However, in parts of western kirthar province and Quetta region the contact is unconformable with the Kirthar or Laki Formations; the upper contact with the Lei Conglomerate is usually unconformable. The group has yielded an abundant vertebrate fauna consisting of nearly all types of mammals together with varieties of reptiles, fish and birds. The vertebrate fauna indicates Middle Miocene to Early Pleistocene age. The group is correlated with parts of Hinglaj and Gwadar Formations of the Baluchistan Basin (Cheema et al., (1977). A Simplified Geological Map of the district is presented as **Fig. 14.2**.

14.4 Construction Material Prospecting

The geologic formations exposed within the district were carefully evaluated for their potential with respect to procurement of material for construction of buildings, bridges

Geological Map of District Sudhnuti

Figure-14.2

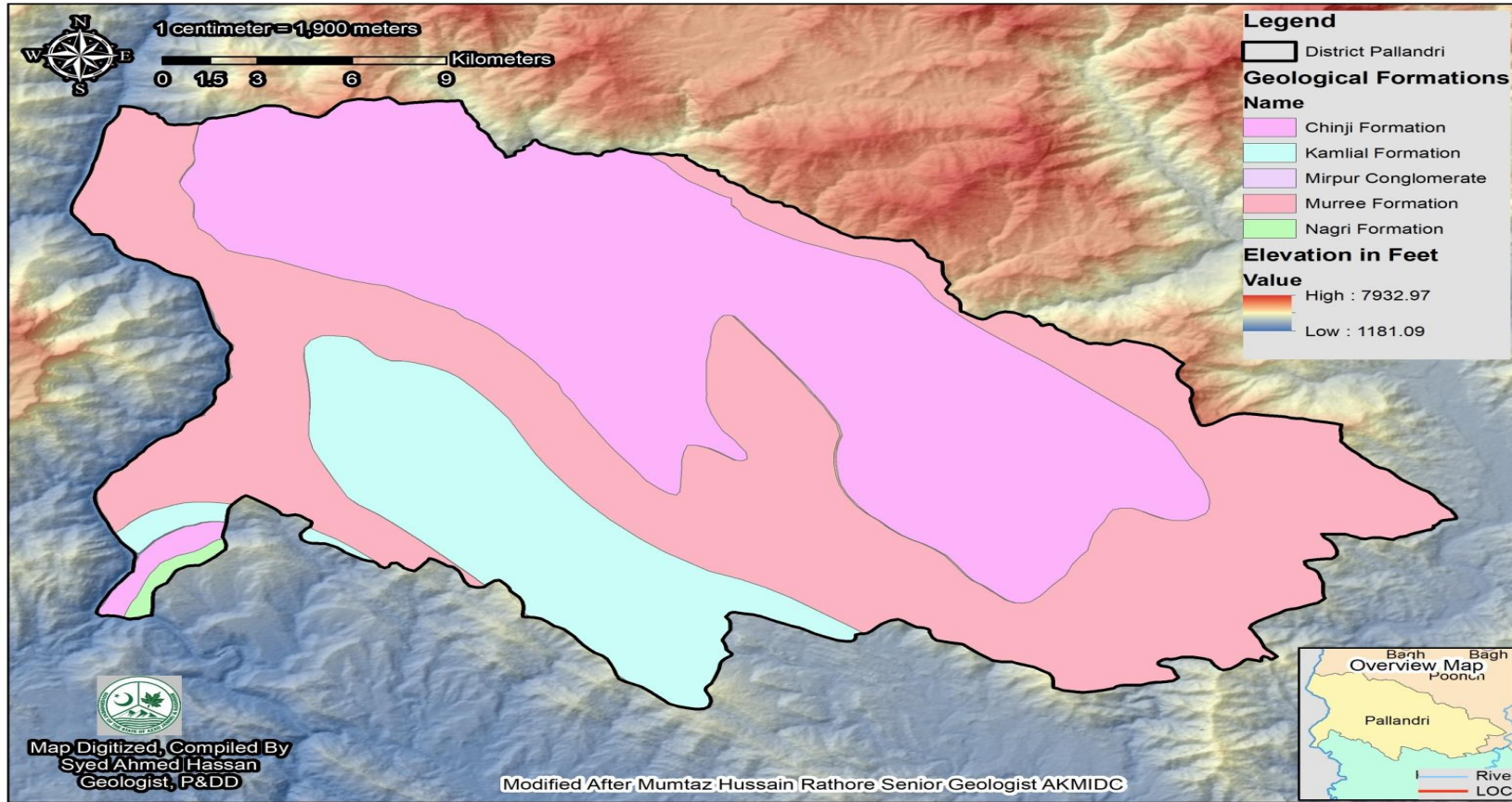


Figure 14.2: Geological Map of District Sudhnuti

and roads. For this purpose, the geologic formations were categorized with respect to the broad engineering characteristics of various rock types. A summary of the inferences derived from this simplified map is presented below and illustrated at **Figure 14.3**:

The rocks belonging to Siwalik Group have no prospect for concrete and asphalt aggregate.

Siwalik Group including Early Siwaliks (Chinji Formation) and middle Siwaliks (Nagri & Dhok Pathan Formations) covers almost the total district area. The formations lithological descriptions are described below which have no prospect for serving as construction material source.

Chinji Formation:

According to Pilbeam (1977), the formation consists of red clays with subordinate ash and grey to brownish grey sandstone. The sandstone is fine to medium grained, occasionally gritty and cross bedded. Scattered pebbles of quartzite and thin lenses of intra-formational conglomerate are found at different horizons throughout the formation.

Nagri Formation:

The Nagri Formation consists of sandstone with subordinate clays and conglomerate. The sandstone is greenish grey medium to coarse grained, cross bedded and massive. In places, the sandstone is bluish grey dull red with "salt and pepper" texture, calcareous, and moderately to poorly cemented. The clay is sandy or silty chocolate brown or reddish grey and pale orange.

Dhok Pathan Formation:

Cheema et al. (1977) described briefly that the formation is typically represented by monotonous cyclic alternations of sandstone and clay. The sandstone is commonly grey, gleaming white or reddish brown and occasionally brownish grey, greenish grey brown or buff colored, thick bedded, calcareous, moderately cemented, soft and cross bedded. The clay is orange, brown, dull red or reddish brown and occasionally rusty orange, greenish yellowish grey, chocolate colored, calcareous and sandy. Minor intercalations of yellowish-brown siltstone are common. Conglomerate in the form of lenses and a layer is essential character of the upper part.

14.5 Exploration for Construction Material Sources

A comprehensive exploration program for identifying material suitable for use in construction of buildings, roads and bridges was executed in the entire district. The program was based on the local physiographic conditions, assessment of geology and material prospecting, existing sources, relevant deficiencies and State needs. The program activities included systematic identification of sources, preliminary field demarcations and assessments, comprehensive sampling, qualitative and quantitative assessments and rapid environmental examination. These activities were conducted in accordance with the criteria and methodology stated in the previous sections.

Siwalik Group including Early Siwalik (Chinji Formation) and middle Siwalik (Nagri & Dhok Pathan Formations) covers almost the 70-80% part of district area. These formations have thoroughly studied during the fields, which have no prospect as construction material source. The evaluation was made in strict compliance to the criteria stated in Chapter 4.

14.6 Recommended Uses of Suitable Sources

Only three marginal sources are declared suitable for use of any construction types as shown **Table 14.1**. The locations of these sources are shown in **Fig. 14.3** and prospects **Fig 14.4**.

CONSTRUCTION MATERIAL SOURCES IN AND AROUND AZAD JAMMU & KASHMIR
TABLE 14.1

Recommended Uses of Various Material Sources in District Sudhnuti

QUARRY NAME	Source Code	TYPE OF CONSTRUCTION																														
		STRUCTURES WITH GREATER LIFE RISK													STRUCTURES WITH LESS LIFE RISK						ROADS											
		Private Houses and Public Buildings (Schools, BHU, etc. of max. 2 storeys)						Major Public Buildings (Colleges, Hospitals and Bridges etc.)							Causeways		Culverts		Concrete		Masonry walls		Inter-district Roads	Intra-district Roads	Community Roads							
		Stone	Non-Load Bearing Concrete Blocks	Load Bearing Concrete Blocks (2000 psi)	Lean Concrete	Concrete upto 2000 psi	Concrete 2000-4000 psi	Stones	Non-Load Bearing Concrete Blocks	Load Bearing Concrete Blocks (2000 psi)	Lean Concrete	Concrete upto 2000 psi	Concrete 2000-4000 psi	High Strength Concrete	Pre-stressed Concrete	Stone	Lean Concrete	Concrete (Upto 3000 psi)	Stone	Lean Concrete	Reinforced Concrete (3000psi)	Lean Concrete	Concrete (Upto 3000 psi)	Stones	Lean Concrete	Concrete (3000 psi)	Base / Sub Base	Asphalt Layer	Sub Base / Soling	Asphalt Layer	Soling	Asphalt Layer
Plandri (Outcrop)	SD-1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Ghoji Nullah (Outcrop)	SD-2	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Ghoji Nullah bed	SD-3	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Pura (Outcrop)	SD-4	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Mang (Outcrop)	SD-5	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Tangi Gala (Outcrop)	SD-6	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Baluch (Outcrop)	SD-7	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Pattan Bhatea (Outcrop)	SD-8	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Pappe Nar Sandstone(Outcrop)	SD-9	✓	✓	✓	✓	✓	x	✓	✓	✓	✓	x	x	x	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Pappe Nar Sandstone(Outcrop)	SD-10	✓	✓	✓	✓	✓	x	✓	✓	✓	✓	x	x	x	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Nar Brahmanan Sandstone(Outcrop)	SD-11	✓	✓	✓	✓	✓	x	✓	✓	✓	✓	x	x	x	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Suitable ✓		Not Suitable x																														

The recommendations are based on the presumption that the available cement type in the State is Ordinary Portland Cement.

NOTES:

- The sources SD-1 to SD-8 can not be used for any type of construction. These sources are soft, friable and of premature in nature.
- The sources SD-9 to SD-11 can be used for concrete with the following options if declared non recommended on the basis of ASR susceptibility, however this require source specific study.
 - Low Alkali Cement (Alkalis as Na₂O less than 0.4%)
 - Slag Cement or Pozzolanitic Cement
 - Using Slag, Fly Ash or Silica Fume as Partial Replacement with the OPC
- The reactive aggregates are being recommended for few concrete classes keeping in view that the cement content in such concrete is quite low. The total alkalis in concrete will not increase the threshold level of 2.5kg/ cu.m.

Sample Location Map, District Sudhnuti

Figure-14.3

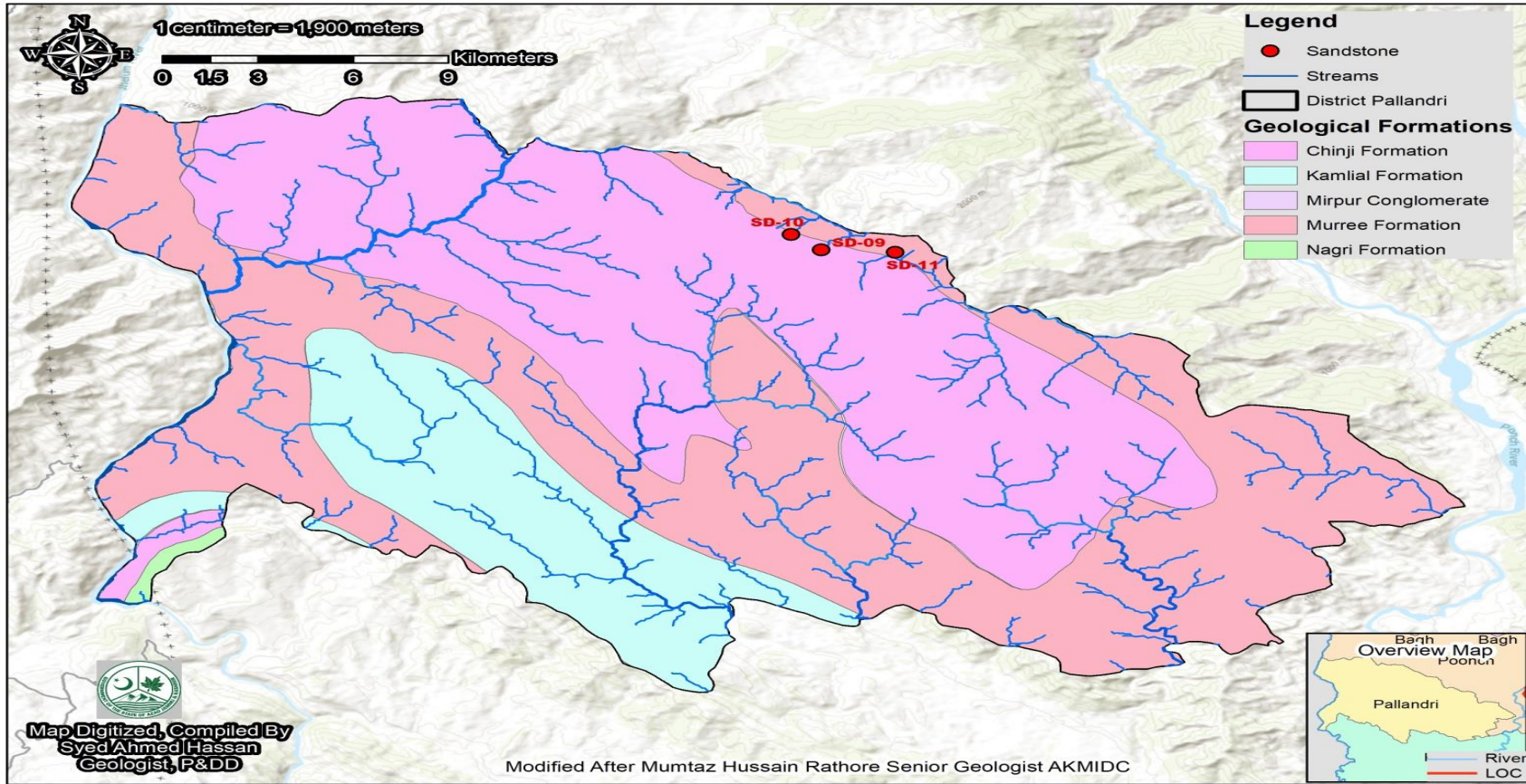


Figure 14.3: Sample Location Map of District Sudhnuti

%age Distribution of Geological Formations w.r.t. Construction Material Prospect, District Sudhnuti **Figure 14.4**

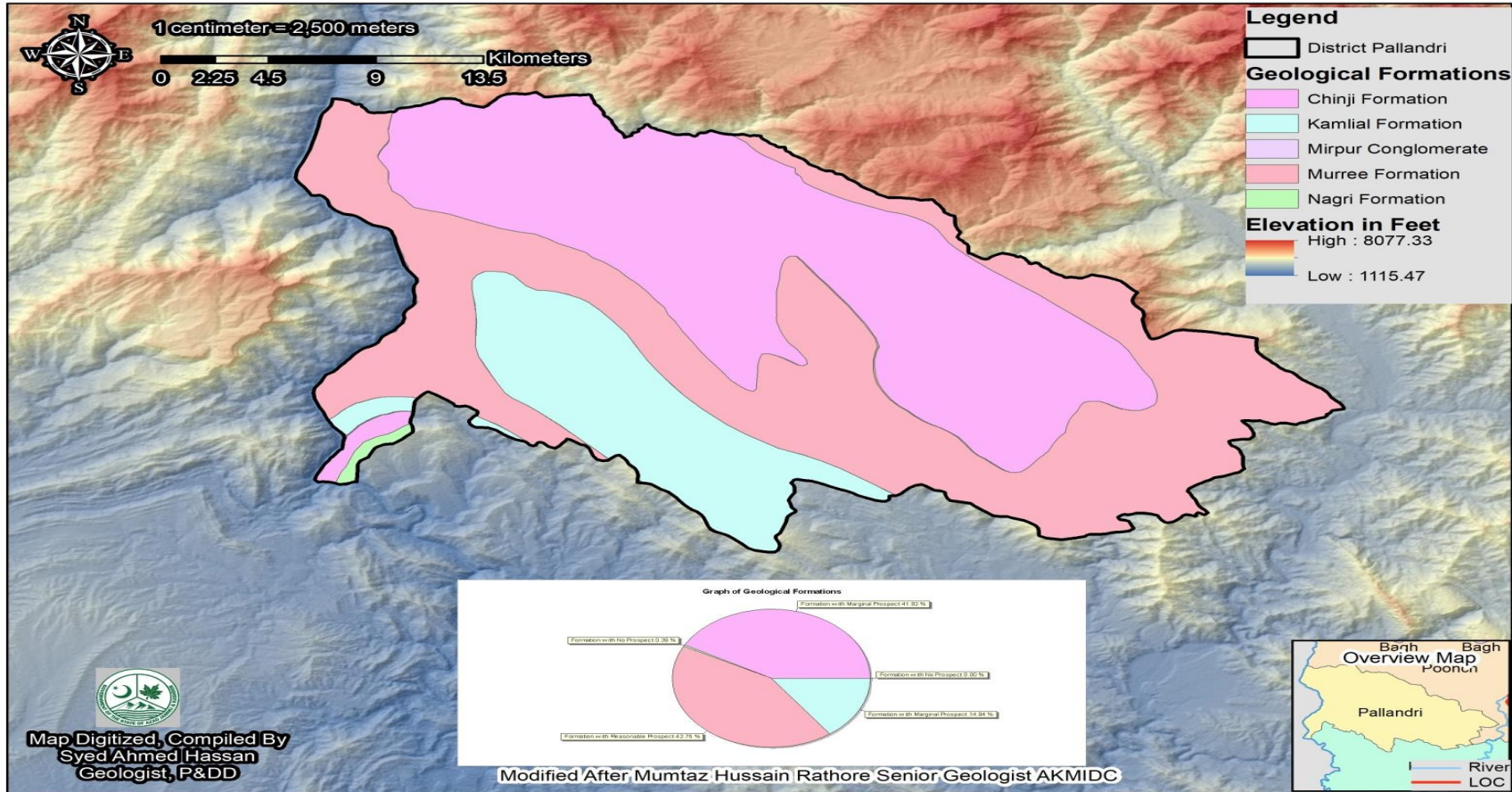


Figure 14.4: Construction Material Prospects of District Sudhnuti

CHAPTER 15

CONSTRUCTION MATERIAL SOURCES STUDY IN ADJOINING AREAS OF PAKISTAN

15.1 General

Presently the State largely depends on the construction material sources located in the far-off reaches of Pakistan. Important details concerning these sources along with a few new sources are briefly discussed. Considering the level of dependency on these sources and in order to make the study more meaningful and result oriented, it was decided to include them in the study beyond the requirements of the Terms of Reference.

These sources; from where material is being presently transported to the State, were studied in accordance with the work methodology stated in the previous chapters. The study included (a) identification, (b) evaluation of physical conditions, (c) qualitative evaluation and (d) determination of their suitability for use as construction material for buildings, roads and bridges.

The material sources identified in this regard are located in Khyber Pakhtunkhwa (KPK) and in Punjab Pakistan. The material from only two (2) of these sources are allowed in the Composite Schedule of Rates (CSR) of AJ&K. The material from other sources are not allowed in the CSR despite being located at much closer distances and used for various construction purposes in the State.

The study has revealed that all these sources are suitable and can be utilized for the intended construction purposes. This chapter additionally provides comprehensive study details specific to each source identified and evaluated. This information forms basis of all analyses and procurement plans.

15.2 Adjoining Areas of Pakistan

The State of Azad Jammu and Kashmir (AJ&K) is connected with Pakistan through various road links, these roads are used for transportation of the construction material. These links include (a) Taxila-Abbottabad-Muzaffarabad-Kohala-Bagh (b) Taxila-Rawalpindi-Murree-Kohala-Bagh (c) Mangla-Dina (d) Gulpur-Kahuta, and (e) Ghari Habibullah-Muzaffarabad and (f) Kahuta-Azad Pattan and Goi nullah -Poonch/ Sudhnuti. Considering the above, it was decided to include the existing sources; located around these road links, in the current study. These sources are located in and around Taxila, Abbottabad, Lora Maqsood and Bakot.

15.3 Exploration for Construction Material Sources

A comprehensive exploration program was executed in the adjoining areas of AJ&K. The program activities included identification of existing and new sources, preliminary field demarcations and assessments, comprehensive sampling, qualitative assessments, and quantitative assessments. These activities were conducted in accordance with the criteria and methodology stated in the previous sections. A summary of the exploration program is given below:

- Four (4) existing sources were identified between Taxila and Muzaffarabad, which are currently being used for coarse aggregate, and base/ sub-base material. These sources include (a) Margalla Limestone Quarry, (b) Rohi Nullah Gravel, (c) Dor River Gravel, and (d) Gummamah Limestone Quarry. These sources are located at

a distance of 140 km, 138 km, 110 km and 86 km respectively from Muzaffarabad via Garhi Habib Ullah. All construction material brought in the State from these sources is referred to as “Margalla Crush”, irrespective of the source.

- An existing source was identified on Lora-Maqsood road near Ghora Gali, which is also currently being exploited for coarse aggregate and base/sub-base material. This source is at a distance of 38 km from Kohala. However, very little quantity is brought to the State from this source despite of its proximity as compared to the Margalla Limestone Quarry.
- Lawrencepur sand deposits, which are currently being exploited for fine aggregate. No alternate source for fine aggregate is available in the adjoining areas.
- Two (2) new sources were identified in Bakot, district Abbottabad near Kohala, AJ&K. These sources include (a) Bakot Limestone Quarry and (b) Bakot Nathia Gali Limestone Quarry.

A summary of the exploration program is given below for Southern districts:

- The Margalla Limestone quarries near Taxila, which are currently being used for coarse aggregate is located at a distance of 75 km and 150 km respectively from Kotli and Mirpur via G.T. Road. All construction material brought in the State from these sources is referred to as “Margalla Crush”, irrespective of the source.
- An existing source was identified near Chak Doulat, which is also currently being exploited for coarse aggregate. This source is at a distance of 40 km from Mirpur City. This source is being used for pre-cast concrete by the Izhar Construction.
- The Pandori riverbed and terrace deposits are an existing source of construction material located on the right bank of River Jhelum near the Baral Colony.
- Chenab sand deposits, which are currently being exploited for fine aggregate for the private construction in AJ&K and Punjab.
- An existing source of abandoned limestone quarry (in past run by FWO) was identified near Tarki near (Domaili), 7 km off the G.T. Road in district Jhelum.
- Lawrencepur sand deposits, which are currently being exploited for fine aggregate.
- Due to the geographical location of the Neelum, Poonch and Sudhnuti districts, the relevant sources of material requiring consideration include the following:
 - The Margalla Limestone quarries near Taxila, which are currently being used for coarse aggregate in these districts. All construction material brought in the State from these sources is referred to as “Margalla Crush”, irrespective of the source.
 - Lawrencepur sand deposits, which are currently being exploited for fine aggregate. No alternate source for fine aggregate is available in the adjoining areas for these districts.
 - Bakot limestone quarry near Kohala in Abbottabad District identified during the Study.
 - Rapid environmental examination of six sources was conducted in the very beginning of the exploration. Moreover, a comprehensive review of the existing quarrying techniques and material procurement procedures was carried out.

- Hand samples were collected from seven (07) sources, out of which selected representative samples were analyzed through petrographic microscope after preparing thin sections. Set of petrographic analysis results for four sources were evaluated with respect to perspective usages of the material.
- Bulk samples were collected from these sources, out of which selected representative samples were analyzed for physical properties at the Central material Testing Laboratory, WAPDA. The testing program was prepared considering the expected uses of the material and laboratory test results were accordingly evaluated.

Locations of all the sources of adjoining areas of Pakistan are shown in **Fig. 15.1**.

15.4 Source Digests

Detailed information pertinent to an individual source is put together in the form of "Source Digest". The information relates to (a) location and accessibility, (b) physiographic and geologic conditions, (c) environmental appraisal, (d) extent of investigations conducted, (e) summary results of investigations, (f) principal evaluations, and (g) recommendations. The source digests are organized alpha-numerically for efficient tracking of information.

The information provided in the respective source digests supports the analyses and procurement plans.

15.5 Suitability of the Investigated Sources

A careful evaluation of the investigated sources was conducted to establish their suitability in broad terms as construction material. The evaluation was made strictly comparing the technical data collected during the exploration stage with the criteria established for this purpose. A summary of the evaluation results is given below:

- All the five (5) rock and nullah bed sources located in the adjoining areas are rated as suitable for quarrying coarse aggregate for producing (a) concrete of varying strength, (b) asphalt road works, and (c) base/ sub-base road elements.
- Lawrencepur Sand Deposits are rated as suitable for all purposes.
- Two (02) new rock sources identified in the close proximity of Kohala are rated as suitable for quarrying coarse aggregate for producing (a) concrete of varying strength, and (b) base/ sub-base road elements.
- The two (02) riverbed sources located on the Jhelum river downstream of the Jhelum river are rated as suitable for marginal use.
- Chenab Sand deposits are marginal.
- Limestone quarry near Tarkai is rated as suitable for quarrying coarse aggregate for producing (a) concrete of varying strength, and (b) base/ sub-base road elements.

Suitability of each of the explored sources is made in the respective "Source Digest".

15.6 Recommended Uses of Suitable Sources

The sources declared suitable have varying petrographic, physical and engineering characteristics. A cautious evaluation of the characteristics of each source was carried out to identify its appropriate uses as construction material in light of the Composite Schedule of Rates for AJ&K.

Based on this evaluation, the recommended uses of all the sources for various construction types are indicated in **Table. 15.1**.

15.7 Quantitative Estimate of Material Availability

The sources declared suitable have material that is mentioned in the respected source digests. A quick appraisal of the available sources and their recommended uses had brought forward following major inferences:

- All existing sources have exceptionally huge quantities of material and may sufficiently meet the State requirements for years to come.
- Both the new sources located in the proximity of Kohala have huge quantities and thus may also sufficiently meet the State requirements for years to come if developed and managed properly.
- The source located near Domaili has huge quantity and thus may also sufficiently meet the adjoining areas requirements for years to come if developed and managed properly.

The above inferences are made in broader terms and can be used for developing material procurement plan for AJ&K.

CONSTRUCTION MATERIAL SOURCES IN AND AROUND AZAD JAMMU & KASHMIR

TABLE 15.1

Recommended Uses of Various Material Sources in Adjoining Areas of Pakistan

QUARRY NAME	Source Code	TYPE OF CONSTRUCTION																														
		STRUCTURES WITH GREATER LIFE RISK										STRUCTURES WITH LESS LIFE RISK						ROADS														
		Private Houses and Public Buildings (Schools, BHU, etc. of maximum two storeys)					Major Public Buildings (Colleges, Hospitals and Bridges etc.)					Causeways		Culverts		Concrete		Masonry walls		Inter-district Roads		Intra-district Roads		Community Roads								
		Stone	Non-Load Bearing Concrete Blocks	Load Bearing Concrete Blocks (2000 Psi)	Lean Concrete	Concrete upto 2000 psi	Concrete 2000-4000 psi*	Stones	Non-Load Bearing Concrete Blocks	Load Bearing Concrete Blocks	Lean Concrete	Concrete upto 2000 psi	Concrete 2000-4000 psi *	High Strength Concrete *	Pre-stressed Concrete	Stone	Lean Concrete	Concrete (Upto 3000 psi) *	Stone	Lean Concrete	Reinforced Concrete (3000psi)	Lean Concrete	Concrete (Upto 3000 psi) *	Stones	Lean Concrete	Concrete (3000 psi)	Base / Sub Base	Asphalt Layer	Sub Base / Soling	Asphalt Layer	Soling	Asphalt Layer
Bakot Limestone	P-1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	▲	▲	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Bakot Nathiagali Limestone	P-2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	▲	▲	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Lora Maqsood Limestone	P-3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	▲	▲	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	×	✓	×	✓	×	✓	
Gummamah Limestone Abbottabad	P-4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	▲	▲	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Rohi Nullah Bed Material ^(a)	P-5	×	✓	✓	✓	✓	×	✓	✓	✓	✓	✓	▲	▲	×	✓	✓	×	✓	✓	✓	✓	✓	×	✓	✓	×	✓	×	✓	×	
Dor River Bed Material ^(b)	P-6	×	✓	✓	✓	✓	×	✓	✓	✓	✓	✓	▲	▲	×	✓	✓	×	✓	✓	✓	✓	✓	×	✓	✓	×	✓	×	✓	×	
Margalla Limestone ^(c)	P-7	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Lawrencepur Sand Deposit	P-8																															
Chenab Sand	P-9																															

Suitable ✓ Project Specific Studies including Mix Design ▲ Not Suitable ×

The recommendations are based on the presumption that the available cement type in the State is Ordinary Portland Cement.

Requires Mix Design in Recommended Case *

NOTES:

- (a) and (b) , These sources are riverbed material. The usage as Aggregate Base Course will require to meet the specifications of crushed and rounded faces percentage.
- (c) The recommendations are based on present study and previous study carried out at various projects.

Sample Location Map of Adjoining Areas of Pakistan

Figure: 15.1

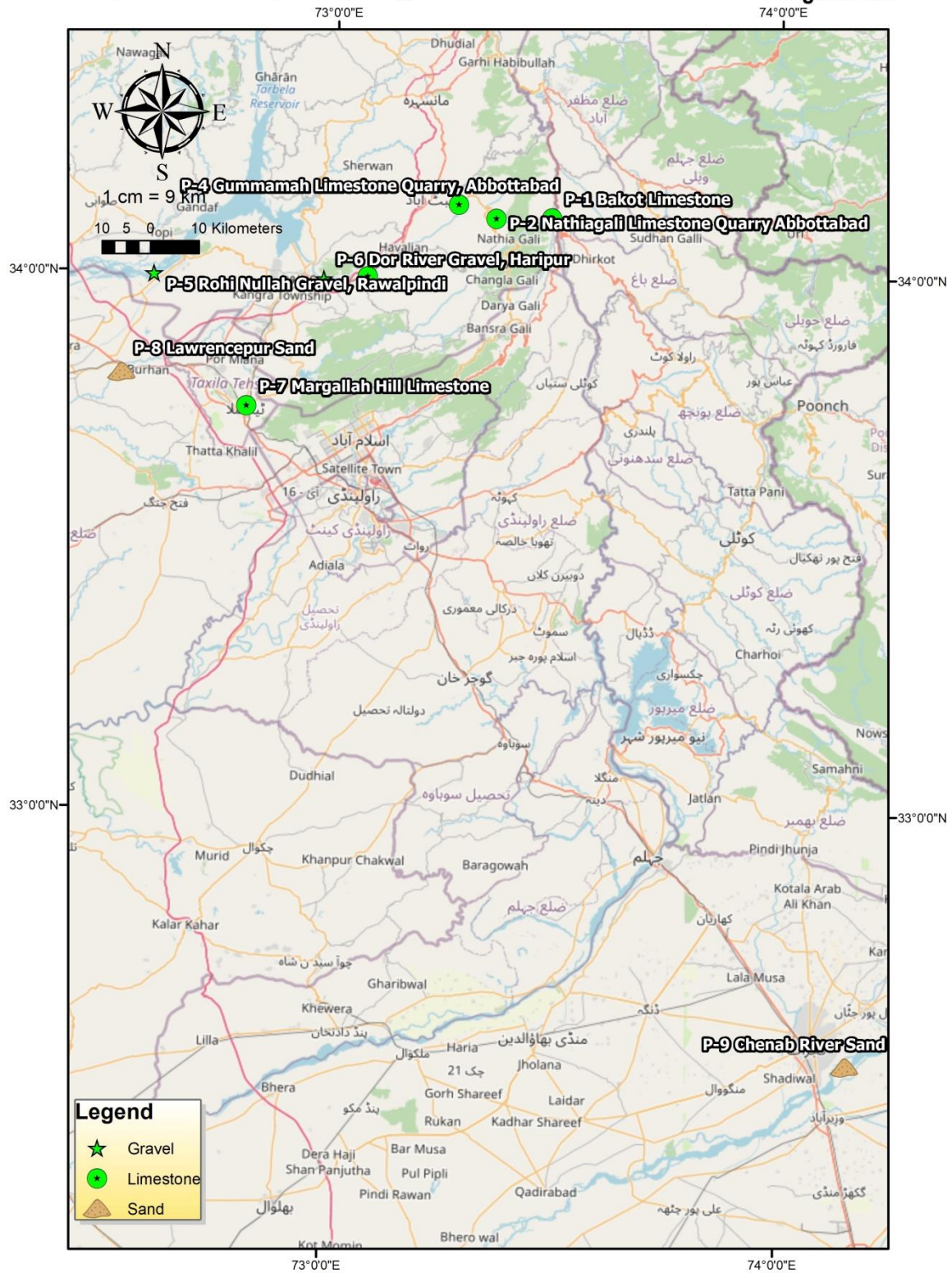


Figure 15.1: Sample Location Map of Adjoining Areas of Pakistan

CHAPTER 16

CONSTRUCTION MATERIAL PROCUREMENT PLANS

16.1 General

Study of construction material within AJ&K and adjoining areas of Pakistan has been completed as per the Terms of Reference. Comprehensive details of the study conducted, and evaluation results of the identified material sources are summarized in the previous chapters. It is important to note that numerous existing and new sources have been rated as useful for various construction works and thus can be immediately exploited for public and private purposes.

In this chapter, district wise plans for procurement of construction material for consideration by the Government of AJ&K. The plans comprehend both immediate and long-term recommendations necessary for taking benefits from the study findings. The plans also include important recommendations for (a) modifications in the current Composite Schedule of Rates (CSR) to get benefits for the public sector and (b) publicizing information concerning the newly identified sources for the benefit of private sector or non-government agencies. Important aspects considered for (a) preparing the procurement plans and recommending actions to regularize the procurement plan in Composite Schedule of Rates are also provided hereunder.

16.2 Considerations for Procurement Plans

Important aspects considered for preparing procurement plans for all districts are briefly stated below:

- The plan should be based on the potential uses of the sources recommended on the basis of current study.
- Local sources should be given priority.
- Dependency on the sources located outside AJ&K should be gradually reduce.
- Available material quantities, relative distances and transportation ease should be considered while preparing material procurement plan.

16.3 Considerations for Regularization of Procurement Plan in CSR

Important aspects considered for recommending actions to regularize the procurement plans for AJ&K in Composite Schedule of Rates are briefly stated below:

- All existing and new sources; located in AJ&K or Pakistan, having suitable material should be included in the CSR as "Approved Sources" for particular uses.
- All new sources located in AJ&K should be recommended for development and leasing.
- The existing sources already approved in the CSR should not be removed.

16.4 Material Procurement Plan for District Muzaffarabad, AJ&K

Material procurement plan for district Muzaffarabad for buildings and roads is given in **Tables 16.1** and **16.2**. Important aspects of the plan are discussed below:

- The plan envisages gradual reduction in dependency of far off sources located in Pakistan for coarse aggregate.

CONSTRUCTION MATERIAL SOURCES IN AND AROUND AZAD JAMMU & KASHMIR

Table 16.1

Plan for Construction Material Procurement for Buildings and Bridges in District Muzaffarabad , AJ&K

Aggregate Type	Recommended Usage with Ordinary Portland Cement	Source Designation and Title		Proposed Service Area	Recommendations for Procurement of Coarse and Fine Aggregate	Action for Regularization in CSR		
Coarse Aggregate	ALL PURPOSE USAGE RECOMMENDED for Public and Private Buildings and Cross Drainage Structures on Roads	MZ-3	Margalla Limestone (At Yadgar, Batmong, Hill Seri Dera and Zahid Chowk localities)	Muzd. District	1 Allow use of coarse aggregate from local sources MZ-3 and MZ-8.	a. Existing sources located in Pakistan and designated as P-3, P-4, P-5 and P-6 should also be included in the CSR as "Approved Sources" in addition to Margalla Hill Limestone (P-7). Sources P-3 and P-4 are located at much closer distances as compared to the Margalla Hill Limestone (P-7) and thus should be considered for comparison of rates in CSR.		
		MZ-8	Lamnian Dolerite	Muzd. District				
		P-1	Bakot Limestone	Muzd. District	2 Allow use of coarse aggregate from sources P-1 thru P-6 located in Pakistan.	b. Undeveloped sources MZ-3, MZ-8, P-1, and P-2 should be included in the CSR as "Approved Sources". These sources should be leased and properly developed. Financial credit from these sources would be possible only upon their proper development. Once these sources are developed, dependency on sources in Pakistan should be discouraged.		
		P-2	Bakot-Nathiagali Limestone	Muzd. District				
		P-3	Lora-Maqsood Limestone	Muzd. District				
		P-4	Gummamah Limestone	Muzd. District				
		P-5	Rohi Nullah Gravel	Muzd. District				
		P-6	Dor River Gravel	Muzd. District				
		MARGINAL USAGE Recommended with Ordinary Portland Cement (OPC)	Specific studies required for Large Projects	P-7	Margalla Hill Limestone	Muzd. District	3 Continue use of coarse aggregate from source P-7	c. The existing sources of Makri and Showai located in Muzaffarabad city should be banned immediately.
				MZ-1	Kamsar Dolomitic Limestone	Muzd. District	4 Allow use of coarse aggregate from these sources for all purposes except in production of "High Strength Concrete (more than 3000 psi)". For detailed recommendations refer Table 5.1	d. Existing sources MZ-1 and MZ-2 should also be included in the CSR as "Approved Local Sources" for marginal use as recommended.
	MZ-2			Kamsar Dolomite	Muzd. District			
	MZ-6			Niazpura Dolomitic Limestone	Muzd. District			
	MZ-10	Chattar Kalass Nullah Gravel	Muzd. Tehsil					
	MZ-18	Komi kot Sandstone	Tehsil Muzd.					
NM-12MZ	Balgran volcanics (Meta basalt) (1)	Districts Muzaffarabad						
NM-13MZ	Dhara Balgran Meta Carbonates	Districts Muzaffarabad / Neelum						
Fine Aggregate	ALL PURPOSE USAGE RECOMMENDED	P-8	Lawrencepur Sand	Muzaffarabad	5 Continue use of fine aggregate from Source P-8	f. Existing source P-8 should be retained in the CSR as "Approved Source" for all purpose usage. Lawrencepur filter material source is also recommended for filter media as per project specifications.		
	MARGINAL USAGE Recommended with Ordinary Portland Cement (OPC)	MZ-13	Langarpura River Sand	Muzd. District	6 Allow use of fine aggregate from these sources for all purposes except in production of "High Strength Concrete (more than 3000 psi)". For detailed recommendations refer respective Source Digest.	g. Existing sources MZ-13 thru MZ-16 should also be included in the CSR as "Approved Local Sources" for marginal use as recommended.		
		MZ-14	Dulai River Sand	Muzd. District				
		MZ-15	Barsala River Sand	Muzd. District				
		MZ-16	Chhalpani River Sand	Muzd. & Patika Tehsils				

CONSTRUCTION MATERIAL SOURCES IN AND AROUND AZAD JAMMU & KASHMIR

Table 16.2

Plan for Construction Material Procurement for Roads in District Muzaffarabad, AJ&K

Source Designation and Title		Material Usage	Recommendations for Procurement of Material	Action for Regularization in CSR
MZ-1	Kamsar Dolomitic Limestone	1 Asphalt Aggregate 2 Base/ Sub Base 3 Stone for Masonry and Soling Works	Allow use of material from sources MZ-2, MZ-3, MZ-6, MZ-8, MZ-9 and NM-13MZ Allow use of material from all sources. Allow use of material for soling from all sources. Allow use of material for masonry stone from all sources except Source MZ-2.	a. Existing local sources MZ-3 MZ-2, should be included in the CSR as an "Approved Source" for asphalt aggregate. b. Undeveloped recommended sources MZ-6, MZ-8 and NM-13MZ should be included in the CSR as "Approved Sources" for asphalt aggregate. These sources should leased and properly developed. Financial credit from these sources would be possible only upon their proper development. c. All sources should be included in the CSR as "Approved Local Sources" for base / sub base material. d. All sources except MZ-2 and MZ-3 should be included in the CSR as "Approved Local Sources" for Stone for Masonry and Soling Works.
MZ-2	Kamsar Dolomite			
MZ-3	Margalla Limestone (At Yadgar, Batmong, Hill Seri Dera and Zahid Chowk localities)			
MZ-6	Niazpura Dolomitic Limestone			
MZ-7	Lamnian Metabasalt			
MZ-10	Chattar Kalas Nullah Gravel			
MZ-18	Komi Kot Sandstone			
NM-12MZ	Balgran Volcanics (Meta Basalt)			
NM-13MZ	Dhara Balgran Meta Carbonates			

- There are no suitable sources of fine aggregate in the district, and thus dependency on Lawrencepur Sand Deposits would not be curtailed.
- New sources of suitable material are identified within the district as well as its adjoining areas in Pakistan and are recommended for development.

16.5 Material Procurement Plan for Districts Jhelum Valley, AJ&K

Material procurement plan for district Jhelum Valley for buildings and roads is given in Tables **16.3** and **16.4**. Important aspects of the plan are discussed below:

- The plan envisages gradual reduction in dependency of far-off sources located in Pakistan for coarse aggregate.
- There are no suitable sources of fine aggregate in the district, and thus dependency on Lawrencepur Sand Deposits would not be curtailed.
- New sources of suitable material are identified within the district as well as its adjoining areas in Pakistan and are recommended for development.

16.6 Material Procurement Plan for District Bagh, AJ&K

Material procurement plan for districts Bagh and Haveli for buildings and roads is given in Tables **16.5** and **16.6**. Important aspects of the plan are discussed below:

- The plan envisages gradual reduction in dependency of far off sources located in Pakistan for coarse aggregate. The needs would be met through local sources in Haveli Tehsil as well as from sources located Muzaffarabad district.
- There are no suitable sources of fine aggregate in the district, and thus dependency on Lawrencepur Sand Deposit would not be curtailed.
- New sources of suitable material are identified within the district and are recommended for development.

16.7 Material Procurement Plan for District Haveli, AJ&K

Material procurement plan for districts Bagh and Haveli for buildings and roads is given in Tables **16.7** and **16.8**. Important aspects of the plan are discussed below:

- The plan envisages gradual reduction in dependency of far off sources located in Pakistan for coarse aggregate. The needs would be met through local sources in Haveli Tehsil as well as from sources located Muzaffarabad district.
- There are no suitable sources of fine aggregate in the district, and thus dependency on Lawrencepur Sand Deposit would not be curtailed.
- New sources of suitable material are identified within the district and are recommended for development.

16.8 Material Procurement Plan for district Kotli, AJ&K

Material procurement plan for district Kotli for buildings and roads is given in Tables **16.9** and **16.10**. Important aspects of the plan are discussed below:

- The plan envisages gradual reduction in dependency of far off sources located in Pakistan for coarse aggregate.

CONSTRUCTION MATERIAL SOURCES IN AND AROUND AZAD JAMMU & KASHMIR

Table 16.3

Plan for Construction Material Procurement for Buildings and Bridges in District Jhelum Valley, AJ&K

Aggregate Type	Recommended Usage with Ordinary Portland Cement (OPC)	Source Designation and Title	Proposed Service Area	Recommendations for Procurement of Coarse and Fine Aggregate	Action for Regularization in CSR			
Coarse Aggregate	<p>ALL PURPOSE USAGE RECOMMENDED for Public and Private Buildings and Cross Drainage Structures on Roads</p> <p><i>Specific studies required for Large Projects</i></p>	MZ-3	Margallah Hill Limestone at Batmang Hill Seri Dara, Yadgaar etc.	District Muzaffarabad and Jhelum Valley	1	Allow use of coarse aggregate from local sources MZ-3 and MZ-8.	a.	Existing sources located in Pakistan and designated as P-3, P-4, P-5 and P-6 should also be included in the CSR as "Approved Sources" in addition to Margalla Hill Limestone (P-7). Sources P-3 and P-4 are located at much closer distances as compared to the Margalla Hill Limestone (P-7) and thus should be considered for comparison of rates in CSR.
					2	Allow use of coarse aggregate from sources P-1 thru P-6 located in Pakistan.	b.	Undeveloped sources MZ-3, MZ-8, P-1, and P-2 should be included in the CSR as "Approved Sources". These sources should be leased and properly developed. Financial credit from these sources would be possible only upon their proper development. Once these sources are developed, dependency on sources in Pakistan should be discouraged.
					3	Continue use of coarse aggregate from source P-7	c.	The existing sources of Makri and Showai located in Muzaffarabad city should be banned immediately.
	<p>MARGINAL USAGE Recommended with Ordinary Portland Cement (OPC)</p>	MZ-7	Lamnian Metabasalt	Distt. Jhelum valley	4	Allow use of coarse aggregate from these sources for all purposes except in production of "High Strength Concrete (more than 3000 psi)". For detailed recommendations refer Table 5.1	d.	Existing sources MZ-1 and MZ-2 should also be included in the CSR as "Approved Local Sources" for marginal use as recommended.
		MZ-9	Chakhama Metabasalt	Distt. Hattian				
		MZ-12	Sundari Bandi Sandstone	Tehsil Jhelum Valley				
Fine Aggregate	<p>ALL PURPOSE USAGE RECOMMENDED</p>	P-8	Lawrencepur Sand	District Jhelum Valley	5	Continue use of fine aggregate from Source P-8	f.	Existing source P-8 should be retained in the CSR as "Approved Source" for all purpose usage. Lawrencepur filter material source is also recommended for filter media as per project specifications.
	<p>MARGINAL USAGE Recommended with Ordinary Portland Cement (OPC)</p>		Local Sand Deposits	District Jhelum Valley	6	Allow use of fine aggregate from these sources for all purposes except in production of "High Strength Concrete (more than 3000 psi)". For detailed	g.	Existing sources MZ-13 thru MZ-16 should also be included in the CSR as "Approved Local Sources" for marginal use as recommended.

CONSTRUCTION MATERIAL SOURCES IN AND AROUND AZAD JAMMU & KASHMIR

Table 16.4

Plan for Construction Material Procurement for Roads in District Jhelum Valley, AJ&K

Source Designation and Title		Material Usage	Recommendations for Procurement of Material	Action for Regularization in CSR	
MZ-1	Kamsar Dolomitic Limestone	1 Asphalt Aggregate 2 Base/ Sub Base 3 Stone for Masonry and Soling Works	Allow use of material from sources MZ-2, MZ-6, MZ-8, MZ-9 and MZ-3 Allow use of material from all sources. Allow use of material for soling from all sources. Allow use of material for masonry stone from all sources except Source MZ-2	a.	Existing local source MZ-3, MZ-2, should be included in the CSR as an "Approved Source" for asphalt aggregate. Undeveloped recommended sources MZ-6, MZ-8 and NM-13MZ should be included in the CSR as "Approved Sources" for asphalt aggregate. These sources should be leased and properly developed. Financial credit from these sources would be possible only upon their proper development. All sources should be included in the CSR as "Approved Local Sources" for base / sub base material. All sources should be included in the CSR as "Approved Local Sources" for Stone for Masonry and Soling Works.
MZ-2	Kamsar Dolomite				
MZ-3	Margalla Limestone (At Yadgar, Batmong, Hill Seri Dera and Zahid Chowk localities)				
MZ-6	Niazpura Dolomitic Limestone				
MZ-7	Lamnian Metabasalt				
MZ-8	Lamnian Dolerite				
MZ-9	Chakhama Metabasalt				
MZ-10	Chattar Kalas Nullah Gravel				
MZ-11	Eran Sandstone				
MZ-12	Sundari Bandi Sandstone				
MZ-18	Komi Kot Sandstone				

STUDY OF CONSTRUCTION MATERIAL SOURCES IN AND AROUND AZAD JAMMU & KASHMIR

Table 16.5

Plan for Construction Material Procurement for Roads in District Bagh, AJ&K

Source Designation and Title		Material Type		Recommendations for Procurement of Material	Action for Regularization in CSR
MZ-1	Kamsar Dolomitic Limestone	1	Asphalt Aggregate	Allow use of material from sources BG-18, BG-19, P-1 and P-2.	<p>a. Existing local source MZ-2 should be included in the CSR as an "Approved Source" for asphalt aggregate</p> <p>b. Undeveloped recommended sources BG-18, BG-19, and MZ-6 should be included in the CSR as "Approved Sources" for asphalt aggregate. These sources should be leased and properly developed. Financial credit from these sources would be possible only upon their proper development.</p>
MZ-2	Kamsar Dolomite				
MZ-3	Yadgar-Batmang Limestone				
MZ-6	Niazpura Dolomitic Limestone	2	Base/ Sub Base	Allow use of material from sources BG-1 thru BG-19.	<p>c. All sources from BG-1 thru BG-19 should be included in the CSR as "Approved Local Sources" for base/ sub base.</p> <p>d. Sources BG-1 thru BG-19 should be included in the CSR as "Approved Local Sources" for soling works.</p> <p>Sources BG-1 thru BG-10, BG-18 and BG-19 should be included in the CSR as "Approved Local Sources" for masonry works.</p>
BG-1	Malal Bagla Sandstone				
BG-2	Neem Dana Sandstone				
BG-3	Chamman Kot Sandstone				
BG-4	Bees Bagla Sandstone				
BG-5	Ghaziabad Sandstone				
BG-6	Shujabad Sandstone				
BG-7	Patriata Sandstone				
BG-8	Bhont Chowk Sandstone				
BG-9	Dhuli Sandstone				
BG-10	Lasdana Sandstone				
BG-11	Arja-Mahl River Gravel				
BG-12	Rafiqabad-Mahl River Gravel				
BG-13	Harighel-Mahl River Gravel				
BG-14	Qadirabad-Mahl River Gravel				
BG-15	Dhal Qazian-Malwani Kas Gravel	3	Stone for Masonry and Soling Works	<p>Allow use of material for soling from sources BG-1 thru BG-10, BG-18 and BG-19.</p> <p>Allow use of material for stone masonry from sources BG-1 thru BG-10, BG-18 and BG-19.</p>	

STUDY OF CONSTRUCTION MATERIAL SOURCES IN AND AROUND AZAD JAMMU & KASHMIR

Table 16.6

Plan for Construction Material Procurement for Buildings and Bridges in District Bagh, AJ&K

Aggregate Type	Recommended Usage with Ordinary Portland Cement	Source Designation and Title		Proposed Service Area	Recommendations for Procurement of Coarse and Fine Aggregate		Action Sequence to Regulate the Recommendations in CSR		
		MZ							
Coarse Aggregate	ALL PURPOSE USAGE RECOMMENDED for Ordinary Public and Private Buildings.	MZ-3	Yadgar-Batmang Limestone	Bagh, Harighel, Dhirkot Tehsils	1	Allow use of coarse aggregate from local sources MZ-3, BG-18, and BG-19.	a.	Existing sources located in Pakistan and designated as P-3, P-4, P-5 and P-6 should also be included in the CSR as "Approved Sources" in addition to Margalla Hill Limestone (P-7). Sources P-3 and P-4 are located at much closer distances as compared to the P-7.	
		P-1	Bakot Limestone	Bagh, Harighel, Dhirkot Tehsils	2	Allow use of coarse aggregate from sources P-1 thru P-6 located in Pakistan. Material from P-7 is already allowed.	b.	Undeveloped sources MZ-3, BG-18, BG-19, P-1, and P-2 should be included in the CSR as "Approved Sources". These sources should be leased and properly developed. Financial credit from these sources would be possible only upon their proper development. Once these sources are developed, dependency on sources in Pakistan should be discouraged.	
		P-2	Bakot-Nathiagali Limestone	Bagh, Harighel, Dhirkot Tehsils					
		P-3	Lora-Maqsood Limestone	Bagh, Harighel, Dhirkot Tehsils					
		P-4	Gummamah Limestone	Bagh, Harighel, Dhirkot Tehsils					
		P-5	Rohi Nullah Gravel	Bagh District					
		P-6	Dor River Gravel	Bagh, Harighel, Dhirkot Tehsils					
		<i>Specific studies required for Large Projects</i>	P-7	Margalla Limestone	Bagh District	3	Continue use of coarse aggregate from source P-7	c.	Once the new recommended local sources are developed, dependency on sources in Pakistan should be discouraged.
	MARGINAL USAGE Recommended with Ordinary Portland Cement (OPC)	BG-1	Malal Bagla Sandstone	Dhirkot Tehsil	4	Allow use of coarse aggregate from sources BG-1 thru BG-17 and MZ-2, for concrete having strength up to 3000 psi. For detailed recommendation refer Table 6.1.	d.	Sources BG-1 thru BG-17 should be included in the CSR as "Approved Local Sources" for marginal use as recommended. Sources BG-11 thru BG-17 are existing sources. Sources BG-1 thru BG-10 should be leased and properly developed. Financial credit from these sources would be possible only upon their proper development.	
		BG-2	Neem Dana Sandstone	Dhirkot Tehsil					
		BG-3	Chamman Kot Sandstone	Dhirkot Tehsil					
		BG-4	Bees Bagla Sandstone	Bagh, Dhirkot Tehsils					
		BG-5	Ghaziabad Sandstone	Dhirkot Tehsil					
		BG-6	Shujabad Sandstone	Harighel and Bagh Tehsils					
		BG-7	Patriata Sandstone	Harighel and Bagh Tehsils					
		BG-8	Bhont Chowk Sandstone	Bagh Tehsil					
		BG-9	Dhull Sandstone	Bagh Tehsil					
		BG-10	Lasdana Sandstone	Bagh Tehsil					
		BG-11	Arja-Mahl River Gravel	Dhirkot Tehsil					
		BG-12	Rafiqabad-Mahl River Gravel	Harighel and Bagh Tehsils					
BG-13		Harighel-Mahl River Gravel	Harighel and Bagh Tehsils						
BG-14	Qadirabad-Mahl River Gravel	Bagh Tehsil							
BG-15	Dhal Qazian-Malwani Kas Gravel	Bagh Tehsil							
Fine Aggregate	ALL PURPOSE USAGE RECOMMENDED	P-8	Lawrencepur Sand	Bagh and Haveli Districts	5	Continue use of fine aggregate from source P-8	e.	Existing source P-8 should be retained in the CSR as "Approved Source" for all purpose usage. Lawrencepur filter material source is also recommended for filter media as per project specifications.	
	MARGINAL USAGE Recommended with Ordinary Portland Cement (OPC)	MZ-14	Dulai River Sand	Dhirkot, Harighel and Bagh Tehsils	6	Allow use of fine aggregate from all lower Jhelum sources for production of concrete having strength up to 3000 psi. For detailed recommendations refer respective Source Digest.	f.	Existing sources MZ-14 and MZ-15 should also be included in the CSR as "Approved Local Sources" for marginal use as recommended.	
		MZ-15	Barsala River Sand	Dhirkot, Harighel and Bagh Tehsils					

STUDY OF CONSTRUCTION MATERIAL SOURCES IN AND AROUND AZAD JAMMU & KASHMIR

Table 16.7

Plan for Construction Material Procurement for Roads in District Haveli, AJ&K

Source Designation and Title		Material Type	Recommendations for Procurement of Material	Action for Regularization in CSR
BG-18	Khurshidabad Limestone	1 Asphalt Aggregate	Allow use of material from sources BG-18, BG-19, P-1 and P-2.	a. Existing local source MZ-2 should be included in the CSR as an "Approved Source" for asphalt aggregate
BG-19	Khurshidabad Dolerite			
MZ-1	Kamsar Dolomitic Limestone	2 Base/ Sub Base	Allow use of material sources BG-1 thru BG-19.	b. Undeveloped recommended sources BG-10, BG-19, and MZ-0 should be included in the CSR as "Approved Sources" for asphalt aggregate. These sources should be leased and properly developed. Financial credit from these sources would be possible only upon their proper development
MZ-2	Kamsar Dolomite			
MZ-3	Yadgar-Batmang Limestone			
MZ-6	Niazpura Dolomitic Limestone			
BG-16	Palangai Nullah Gravel	3 Stone for Masonry and Soling Works	Allow use of material for soling from sources BG-1 thru BG-10, BG-18 and BG-19.	c. All sources from BG-1 thru BG-19 should be included in the CSR as "Approved Local Sources" for base/ sub base.
BG-17	Tangari- Betar River Gravel			
			Allow use of material for stone masonry from sources BG-1 thru BG-10, BG-18 and BG-19.	d. Sources BG-1 thru BG-19 should be included in the CSR as "Approved Local Sources" for soling works. Sources BG-1 thru BG-10, BG-18 and BG-19 should be included in the CSR as "Approved Local Sources" for masonry works

STUDY OF CONSTRUCTION MATERIAL SOURCES IN AND AROUND AZAD JAMMU & KASHMIR								
Table 16.8								
Plan for Construction Material Procurement for Buildings and Bridges in Districts Bagh and Haveli, AJ&K								
Aggregate Type	Recommended Usage with Ordinary Portland Cement	Source Designation and Title		Proposed Service Area	Recommendations for Procurement of Coarse and Fine Aggregate	Action Sequence to Regulate the Recommendations in CSR		
Coarse Aggregate	ALL PURPOSE USAGE RECOMMENDED for Ordinary Public and Private Buildings.	BG-18	Khurshidabad Limestone	Haveli District	1	Allow use of coarse aggregate from local sources BG-18, and BG-19.	a. Existing sources located in Pakistan and designated as P-3, P-4, P-5 and P-6 should also be included in the CSR as "Approved Sources" in addition to Margalla Hill Limestone (P-7). Sources P-3 and P-4 are located at much closer distances as compared to the P-7.	
		BG-19	Khurshidabad Dolerite	Haveli District				
		P-1	Bakot Limestone	Haveli District				
		P-2	Bakot-Nathiagali Limestone	Haveli District	2	Allow use of coarse aggregate from sources P-1 thru P-6 located in Pakistan. Material from P-7 is already allowed.		b. Undeveloped sources MZ-3, BG-18, BG-19, P-1, and P-2 should be included in the CSR as "Approved Sources". These sources should be leased and properly developed. Financial credit from these sources would be possible only upon their proper development. Once these sources are developed, dependency on sources in Pakistan should be discouraged.
		P-3	Lora-Maqsood Limestone	Haveli District				
		P-4	Gummamah Limestone	Haveli District				
		P-5	Rohi Nullah Gravel	Haveli District				
	P-6	Dor River Gravel	Haveli District	3	Continue use of coarse aggregate from source P-7	c. Once the new recommended local sources are developed, dependency on sources in Pakistan should be discouraged.		
	P-7	Margalla Limestone	Haveli District					
	MARGINAL USAGE Recommended with Ordinary Portland Cement (OPC)	Specific studies required for Large Projects	BG-16	Palangai Nullah Gravel	Haveli District	4	Allow use of coarse aggregate from sources BG-1 thru BG-17 and MZ-2, for concrete having strength up to 3000 psi. For detailed recommendation refer Table 6.1.	d. Sources BG-1 thru BG-17 should be included in the CSR as "Approved Local Sources" for marginal use as recommended. Sources BG-11 thru BG-17 are existing sources. Sources BG-1 thru BG-10 should be leased and properly developed. Financial credit from these sources would be possible only upon their proper development.
BG-17			Tangari- Betar River Gravel	Haveli District				
Fine Aggregate	ALL PURPOSE USAGE RECOMMENDED	P-8	Lawrencepur Sand	Haveli District	5	Continue use of fine aggregate from source P-8	e. Existing source P-8 should be retained in the CSR as "Approved Source" for all purpose usage. Lawrencepur filter material source is also recommended for filter media as per project specifications.	
	MARGINAL USAGE Recommended with Ordinary Portland Cement (OPC)	MZ-14	Palangai Nullah sand	Haveli District	6	Allow use of fine aggregate from all Local Nullah Sources for production of concrete having strength up to 3000 psi. For detailed recommendations refer respective Source Digest.	f. Existing sources MZ-14 and MZ-15 should also be included in the CSR as "Approved Local Sources" for marginal use as recommended.	
		MZ-15	Tangari- Betar River Sand	Haveli District				

CONSTRUCTION MATERIAL SOURCES IN AND AROUND AZAD JAMMU & KASHMIR

Table 16.9

Plan for Construction Material Procurement for Roads in District Kotli, AJ&K

Source Designation and Title		Material Usage	Recommendations for Procurement of Material	Action for Regularization in CSR	
KI-1	Kotli - Nikial Anticline	1 Asphalt Aggregate	Allow use of material from Sources KI-1 and KI-2.	a. Existing local source KI-1 and KI-2 should be included in the CSR as an "Approved Source" for asphalt aggregate.	
KI-2	Khoi Ratta Anticline		Allow use of material from all sources in Sub-base.		
KI-3	Muree Formation	2 Base/ Sub Base	Allow use of material from sources KI-1 and KI-3.	b. All sources should be included in the CSR as "Approved Local Sources" for sub base material. Sources KI-1 to KI-3 should be included in the CSR as "Approved Local Sources" for base material.	
KI-4	Poonch River Gravel-I		Source KI-4 to KI-7 can be used as base with the condition see Table 7.1 Notes.		
KI-5	Poonch River Gravel-II		3 Stone for Masonry and Soling Works		Allow use of material for masonry stone from sources KI-1 ~ KI-3.
KI-6	Poonch Terraces				c. Sources KI-1 to KI-3 should be included in the CSR as "Approved Local Sources" for Stone for Masonry and Soling Works.
KI-7	Khorbun Nullah Gravel				

CONSTRUCTION MATERIAL SOURCES IN AND AROUND AZAD JAMMU & KASHMIR						
Table 16.10						
Plan for Construction Material Procurement for Buildings and Bridges in District Kotli, AJ&K						
Aggregate Type	Recommended Usage with Ordinary Portland Cement (OPC)	Source Designation and Title		Proposed Service Area	Recommendations for Procurement of Coarse and Fine Aggregate	Action for Regularization in CSR
Coarse Aggregate	ALL PURPOSE USAGE RECOMMENDED for Public and Private Buildings and Cross Drainage Structures on Roads	KI-1	Kotli - Nikial Anticline	Kotli District	1 Allow use of coarse aggregate from local sources KI-1 and KI-2. For detail refer to Table 7.1.	a. Existing source located in Pakistan designated as P-7 should be continued in the CSR as "Approved Source" as no other source is located close in Pakistan. The Khurshidabad Limestone and Metadolorite should also be included in CSR as approved material.
		KI-2	Khoi Ratta Anticline	Kotli District		
						2 Continue use of coarse aggregate from source P-7 located in Pakistan.
	MARGINAL USAGE Recommended with Ordinary Portland Cement (OPC)	KI-3	Murree Formation	Kotli District	3 Allow use of coarse aggregate from these sources for all purposes except in production of structures with greater life risk and of "High Strength Concrete (more than 3000 psi)". For detailed recommendations refer Table 7.1	c. Existing sources KI-3 and KI-7 should also be included in the CSR as "Approved Local Sources" for marginal use as recommended.
		KI-4	Poonch River Gravel-I	Kotli District		
		KI-5	Poonch River Gravel-II	Kotli District		
		KI-6	Poonch Terraces	Kotli District		
KI-7		Khorbun Nullah Gravel	Kotli District			
Fine Aggregate	ALL PURPOSE USAGE RECOMMENDED	P-8	Lawrencepur Sand	Kotli District	4 Continue use of fine aggregate from source P-8	d. Existing sources P-8 should be retained in the CSR as "Approved Sources" for all purpose usage. Lawrencepur filter material source is also recommended for filter media as per project specifications.
	MARGINAL USAGE Recommended with Ordinary Portland Cement (OPC)	P-9	Chenab Sand	Kotli District	5 Allow use of fine aggregate from this sources for all purposes except in production of "High Strength Concrete (more than 3000 psi)". For detailed recommendations refer respective Source Digest.	e. Existing source P-9 should also be included in the CSR as "Approved Local Source" for marginal use as recommended.

- There are no suitable sources of fine aggregate in the district, and thus dependency on Lawrencepur and Chenab Sand Deposits would not be curtailed.
- New sources of suitable material are identified within the district are recommended for development and use in Kotli and Mirpur district and even in the Bhimber District.
- The material from Haveli district can also be transported to Kotli via Abbasspur, tehsil of district Poonch.

16.9 Material Procurement Plan for district Mirpur, AJ&K

Material procurement plan for district Mirpur for buildings and roads is given in Tables **16.11** and **16.12**. Important aspects of the plan are discussed below:

- The plan envisages gradual reduction in dependency of far off sources located in Pakistan for coarse aggregate.
- There are no suitable sources of fine aggregate in the district, and thus dependency on Lawrencepur and Chenab Sand Deposits would not be curtailed.
- The blending of Jatilan and crushing dust can be good options for the concrete which has low life risk like causeways, retaining walls and culverts.
- New sources of suitable material are identified within the district and are recommended for development.

16.10 Material Procurement Plan for district Bhimber, AJ&K

Material procurement plan for Bhimber district for buildings and roads is given in Tables **16.13** and **16.14**. Important aspects of the plan are discussed below:

- The plan envisages gradual reduction in dependency of far off sources located in Pakistan for coarse aggregate.
- There is no source of suitable aggregate for durable concrete and asphalt wearing course.
- There are no suitable sources of fine aggregate in the district, and thus dependency on Lawrencepur Sand Deposits would not be curtailed.

16.11 Material Procurement Plan for district Neelum, AJ&K

Material procurement plan for district Neelum for buildings and roads is separately given in Tables **16.15** and **16.16**. Important aspects of the plan are discussed below:

- The plan envisages gradual reduction in dependency of far off sources located in Pakistan for coarse aggregate.
- There are no suitable sources of fine aggregate in the district, and thus dependency on Lawrencepur Sand Deposits would not be curtailed.
- The blending of Neelum river sand can be good options for the concrete which has low life risk like causeways, retaining walls and culverts.
- New sources of suitable material are identified within the district are recommended for development and use in Neelum district.

CONSTRUCTION MATERIAL SOURCES IN AND AROUND AZAD JAMMU & KASHMIR								
Table 16.11								
Plan for Construction Material Procurement for Buildings and Bridges in District Mirpur, AJ&K								
Aggregate Type	Recommended Usage with Ordinary Portland Cement (OPC)	Source Designation and Title		Proposed Service Area	Recommendations for Procurement of Coarse and Fine Aggregate	Action for Regularization in CSR		
Coarse Aggregate	<p>ALL PURPOSE USAGE RECOMMENDED for Public and Private Buildings and Cross Drainage Structures on Roads</p> <p><i>Specific studies required for Large Projects</i></p>	MR-1	Khari Sharif	Mirpur District	1	<p>Allow use of coarse aggregate from local Sources MR-1 and MR-8 for low strength concrete. For detail refer to Table 8.1.</p>	a.	<p>Existing source located in Pakistan and designated as P-7 should also be continued in the CSR as "Approved Source" as no other sources is located close in Pakistan.</p>
		MR-2	Mangla Jatli	Mirpur District				
		MR-3	Jeri Kas	Mirpur District	2	<p>Continue use of coarse aggregate from source P-7 located in Pakistan for all purpose concrete.</p>	b.	<p>No other source equivalent to Margalla Hill Stone P-7 is present within district and close by. The source MR-1 to MR-8 are recommended to be regularize as marginal sources for low strength concrete in higher risk structures and medium strength concrete for low risk concrete refer Table 8.1.</p>
		MR-4	Saketar	Mirpur District				
		MR-5	Kanali Kas	Mirpur District				
		MR-6	Har Kas	Mirpur District				
		MR-7	Ganoi Kas	Mirpur District				
		MR-8	Kot Sarsawa	Mirpur District				
		<p>MARGINAL USAGE Recommended with Ordinary Portland Cement (OPC)</p>						
Fine Aggregate	<p>ALL PURPOSE USAGE RECOMMENDED</p>	P-8	Lawrencepur Sand	Mirpur District	3	<p>Continue use of fine aggregate from source P-8.</p>	c.	<p>Existing source P-8 should be retained in the CSR as "Approved Source" for all purpose usage. Lawrencepur filter material source is also recommended for filter media as per project specifications.</p>
	<p>MARGINAL USAGE Recommended with Ordinary Portland Cement (OPC)</p>	MR-10	Jatilan Sand	Mirpur District	4	<p>Allow use of fine aggregate from this sources for all purposes except in production of "High Strength Concrete (more than 3000 psi)". For detailed recommendations refer respective Source Digest.</p>	d.	<p>Existing sources MR-10 and P-9 should also be included in the CSR as "Approved Local Source" for marginal use as recommended.</p>
		P-9	Chenab Sand	Mirpur District				

CONSTRUCTION MATERIAL SOURCES IN AND AROUND AZAD JAMMU & KASHMIR
Table 16.12

Plan for Construction Material Procurement for Roads in District Mirpur, AJ&K

Source Designation and Title		Material Usage	Recommendations for Procurement of Material	Action for Regularization in CSR
MR-1	Khari Sharif	1 Asphalt Aggregate	No source is suitable for asphalt aggregate.	a. Existing local source P-7 should remain be included in the CSR as an "Approved Source" for asphalt aggregate.
MR-2	Mangla Jatli			
MR-3	Jeri Kas	2 Base/ Sub Base	Allow use of material from all sources in Sub-base.	b. All sources should be included in the CSR as "Approved Local Sources" for sub base material.
MR-4	Saketar			
MR-5	Kanali Kas	3 Stone for Masonry and Soling Works	Sources MR-1 to MR-8 can be used as base material with the condition see Table 8.1 Notes.	Sources MR-1 to MR-8 should be included in the CSR as "Approved Local Sources" for base material with condition as mentioned in Notes Table 8.1.
MR-6	Har Kas			
MR-7	Ganoi Kas			
MR-8	Kot Sarsawa			
			MR-4 is suitable for stone masonry and soling.	c. MR-4 can be used for soling stone subject to condition mentioned in Table 8.1.

CONSTRUCTION MATERIAL SOURCES IN AND AROUND AZAD JAMMU & KASHMIR
Table 16.13

Plan for Construction Material Procurement for Buildings and Bridges in District Bhimber, AJ&K

Aggregate Type	Recommended Usage with Ordinary Portland Cement (OPC)	Source Designation and Title		Proposed Service Area	Recommendations for Procurement of Coarse and Fine Aggregate		Action for Regularization in CSR	
		Code	Name		Code	Description	Code	Description
Coarse Aggregate	ALL PURPOSE USAGE RECOMMENDED for Public and Private Buildings and Cross Drainage Structures on Roads <i>Specific studies required for Large Projects</i>	BB-1	Panjari Nullah	Bhimber District	1 Allow use of coarse aggregate from local Sources BB-1 to BB-3 for low strength concrete. For detail refer to Table 9.1.	2 Continue use of coarse aggregate from source P-7 located in Pakistan.	a. Existing source located in Pakistan designated as P-7 should also be continued in the CSR as "Approved Sources" as no other sources is located close in Pakistan.	
		BB-2	Dhandar Nullah	Bhimber District				
		BB-3	Chaprian	Bhimber District				
	MARGINAL USAGE Recommended with Ordinary Portland Cement (OPC)				b. No other sources equivalent to Margalla Hill Limestone (P-7) is present within district and closeby. The sources BB-1 to BB-3 are recommended to be regularize as marginal sources for low strength concrete in higher risk structures and medium strength concrete for low risk structures refer Table 9.1.			
Fine Aggregate	ALL PURPOSE USAGE RECOMMENDED	P-8	Lawrencepur Sand	District Bhimber	3 Continue use of fine aggregate from source P-8	4 Allow use of fine aggregate from this sources for all purposes except in production of "High Strength Concrete (more than 3000 psi)". For detailed recommendations refer respective Source Digest.	c. Existing source P-8 should be retained in the CSR as "Approved Source" for all purpose usage. Lawrencepur filter material source is also recommended for filter media as per project specifications.	
	MARGINAL USAGE Recommended with Ordinary Portland Cement (OPC)	BB-4	Bhimber Nullah	District Bhimber				
		BB-5	Bhring Nullah	District Bhimber				
		BB-6	Khadala Nullah	District Bhimber				
		BB-7	Samani Nullah	District Bhimber				
		BB-8	Bhimber Samani Road	District Bhimber				
		P-9	Chenab Sand	District Bhimber				
				d. Existing sources P-9 and BB-4-BB-8 should also be included in the CSR as "Approved Local Sources" for marginal use as recommended.				

CONSTRUCTION MATERIAL SOURCES IN AND AROUND AZAD JAMMU & KASHMIR

Table 16.14

Plan for Construction Material Procurement for Roads in District Bhimber, AJ&K

Source Designation and Title		Material Usage	Recommendations for Procurement of Material	Action for Regularization in CSR
BB-1	Panjari Nullah	1 Asphalt Aggregate	No source is suitable for asphalt aggregate.	a. Existing local source P-7 should remain be included in the CSR as an "Approved Source" for asphalt aggregate.
BB-2	Dhandar Nullah			
BB-3	Chaprian	2 Base/ Sub Base	<p>Allow use of material from all sources in Sub-base.</p> <p>Source BB1 to BB3 can be used as base coarse with the condition see Table 9.1 Notes.</p>	b. All sources should be included in the CSR as "Approved Local Sources" for sub base material. Sources BB-1 to BB-3 should be included in the CSR as "Approved Local Sources" for base material with condition as mentioned in Notes Table 9.1.
		3 Stone for Masonry and Soling Works	No source is suitable for stone masnory and soling.	

**CONSTRUCTION MATERIAL SOURCES IN AND AROUND AZAD JAMMU & KASHMIR
Table 16.15**

Plan for Construction Material Procurement for Buildings and Bridges in District Neelum, AJ&K

Aggregate Type	Recommended Usage with Ordinary Portland Cement (OPC)	Source Designation and Title		Proposed Service Area	Recommendations for Procurement of Coarse and Fine Aggregate	Action for Regularization in CSR		
Coarse Aggregate	ALL PURPOSE USAGE RECOMMENDED for Public and Private Buildings and Cross Drainage Structures on Roads	NM-02	Nauseri Dolerite	District Muzaffarabad / Neelum	1 Allow use of coarse aggregate from local sources NM-02, NM-06 and NM-11. For detail refer to Table 10.1.	a. Existing source located in Pakistan and designated as P-7 should be continued in the CSR as "Approved Source" until the local sources are developed.		
		NM-06	Malik Seri Dolerite	District Neelum				
		NM-11	Changa Meta-dolerite	District Neelum	2 Continue use of coarse aggregate from source P-7 located in Pakistan.	b. Undeveloped sources NM-02, NM-06 and NM-11 should be included in the CSR as "Approved Sources". These sources should be leased and properly developed. Financial credit from these sources would be possible only upon their proper development. Once these sources are developed, dependency on sources in Pakistan should be discouraged.		
	MARGINAL USAGE Recommended with Ordinary Portland Cement (OPC)	NM-01	Nauseri Volcanic (Basalt)	District Muzaffarabad / Neelum			3 Allow use of coarse aggregate from these sources for all purposes except in production of structures with greater life risk and of "High Strength Concrete". For detailed recommendations refer Table 10.1	c. Existing sources NM-01, NM-05, NM-12MZ and NM-13MZ should also be included in the CSR as "Approved Local Sources" for marginal use as recommended.
		NM-05	Dudhnial Meta Carbonates	District Neelum				
		NM-12MZ	Balgran Volcanics (Meta basalt)	District Muzaffarabad / Neelum				
		NM-13MZ	Dhara Balgran Meta Carbonates	District Muzaffarabad / Neelum				
Fine Aggregate	ALL PURPOSE USAGE RECOMMENDED	P-8	Lawrencepur Sand	District Neelum	4 Continue use of fine aggregate from source P-8	d. Existing source P-8 should be retained in the CSR as "Approved Source" for all purpose usage. Lawrencepur filter material source is also recommended for filter media as per project specifications.		
	MARGINAL USAGE Recommended with Ordinary Portland Cement (OPC)	NM-07	Neelum River Sand (Kel - Sharda - Kharigam - Changan-Keran-Salkhala)	District Neelum	5 Allow use of fine aggregate from this sources for all purposes except in production of "High Strength Concrete ". For detailed recommendations refer respective Source Digest.	e. Existing source NM-07 should also be included in the CSR as "Approved Local Source" for marginal use as recommended.		

CONSTRUCTION MATERIAL SOURCES IN AND AROUND AZAD JAMMU & KASHMIR
Table 16.16

Plan for Construction Material Procurement for Roads in District Neelum, AJ&K

Source Designation and Title		Material Usage	Recommendations for Procurement of Material	Action for Regularization in CSR
NM-01	Nauseri Volcanics (Basalt)	1 Asphalt Aggregate	Allow use of material from Sources NM-02, NM-05 ,NM-06, NM-11 and NM-13MZ .	a. Existing local sources NM-02, 05 NM-06 ,NM-11 and NM-13MZ should be included in the CSR as an "Approved Source" for asphalt aggregate. b. All mentioned sources should be included in the CSR as "Approved Local Sources" for sub base material. c. All sources should be included in the CSR as "Approved Local Sources" for Stone for Masonry and Soling Works except NM-08 and 09.
NM-02	Nauseri Dolerite			
NM-03	Islampur-Jura Granite	2 Base/ Sub Base		
NM-04	Neelum Granite			
NM-05	Dudhnial Meta Carbonates			
NM-06	Malik Seri Dolerite			
NM-08	Sharda - Sheikh Bela Schist	3 Stone for Masonry and Soling Works		
NM-09	Kel - Sheikh Bela Schist			
NM-10	Dhokran Gneiss, Kel			
NM-11	Changa Meta-dolerite			

16.12 Material Procurement Plan for district Poonch, AJ&K

Material procurement plan for district Poonch for buildings and roads is separately given on **Table 16.17** and **16.18**. Important aspects of the plan are discussed below:

- The plan envisages gradual reduction in dependency of far off sources located in Pakistan for coarse aggregate.
- There is no source of suitable aggregate for durable concrete and asphalt wearing course. However, benefits can be gained from the sources identified in Forward Kahuta, Haveli district and Bakot Limestone and Lora Maqsood from adjoining areas of Pakistan.
- There are no suitable sources of fine aggregate in the district, and thus dependency on Lawrencepur Sand Deposits would not be curtailed.
- New sources of suitable marginal material are identified within the district for structures having low life risk and are recommended for development.

16.13 Material Procurement Plan for district Sudhnuti, AJ&K

Material procurement plan for district Sudhnuti for buildings and roads is given in **Tables 16.19** and **16.20**. Important aspects of the plan are discussed below:

- There is no source of suitable aggregate for concrete and road in the district. Therefore, the dependency on sources on neighboring districts and Pakistan will remain continue.
- There are no suitable sources of fine aggregate in the district, and thus dependency on Lawrencepur Sand Deposits would not be curtailed.

CONSTRUCTION MATERIAL SOURCES IN AND AROUND AZAD JAMMU & KASHMIR

Table 16.17

Plan for Construction Material Procurement for Buildings and Bridges in District Poonch, AJ&K

Aggregate Type	Recommended Usage with Ordinary Portland Cement (OPC)	Source Designation and Title		Proposed Service Area	Recommendations for Procurement of Coarse and Fine Aggregate	Action for Regularization in CSR
Coarse Aggregate	ALL PURPOSE USAGE RECOMMENDED for Public and Private Buildings and Cross Drainage Structures on Roads	P-7	Margalla Hill Limestone	District Poonch	1 Allow use of coarse aggregate from Sources P-1, P-7, BG-18 and BG-19 for high strength concrete. For detail refer to Table 11.1.	a. Existing source located in Pakistan designated as P-7 should be continued in the CSR as "Approved Source" along with sources P-1, BG-18 and BG-19.
		BG-18	Khurshidabad Limestone	District Poonch		
		BG-19	Khurshidabad Dolerite	District Poonch		
		P-1	Bakot Limestone	District Poonch		
		<i>Specific studies required for Large Projects</i>				
	MARGINAL USAGE Recommended with Ordinary Portland Cement (OPC)	PN-1	Arja - Dalkot Section (Outcrop)	District Poonch	2 Allow use of coarse aggregate from these sources for all purposes except in production of structures with greater life risk and of "high Strength Concrete)". For detailed recommendations refer Table 11.1	b. The sources PN-1 to PN-7 are recommended to be regularize as marginal sources for low strength concrete in higher risk structures and medium strength concrete for low risk concrete refer Table 11.1.
		PN-2	Goi Nullah - Rawalakot Section (Outcrop)	District Poonch		
		PN-3	Rawalakot - Khai Gala - Hajira Section (Outcrop)	District Poonch		
		PN-4	Hajira - Abbasspur - Haveli Section (Riverbed)	District Poonch		
		PN-5	Hajira - Abbasspur - Haveli Section (Outcrop)	District Poonch		
PN-6		Jaboti-Ali Sojal Section(Outcrop) Shaheed Gala	District Poonch			
PN-7		Jaboti-Tolipeer Section(Outcrop)	District Poonch			
Fine Aggregate	ALL PURPOSE USAGE RECOMMENDED	P-8	Lawrencepur Sand	District Poonch	3 Continue use of fine aggregate from source P-8	c. Existing source P-8 should be retained in the CSR as "Approved Source" for all purpose usage. Lawrencepur filter material source is also recommended for filter media as per project specifications.

CONSTRUCTION MATERIAL SOURCES IN AND AROUND AZAD JAMMU & KASHMIR

Table 16.18

Plan for Construction Material Procurement for Roads in District Poonch, AJ&K

Source Designation and Title		Material Usage	Recommendations for Procurement of Material	Action for Regularization in CSR
PN-1	Arja - Dalkot Section (Outcrop)	1 Asphalt Aggregate	No source is suitable for asphalt aggregate.	a. Existing source P-7 should remain be included in the CSR as an "Approved Source" for asphalt aggregate. New sources P-1, BG-18 and BG-19 should be added as approved sources.
PN-2	Goi Nullah - Rawalakot Section (Outcrop)		2 Base/ Sub Base	
PN-3	Rawalakot - Khai Gala - Hajira Section (Outcrop)	3 Stone for Masonry and Soling Works		Source PN-4 can be used as base with the condition see Table 11.1 Notes.
PN-4	Hajira - Abbasspur - Haveli Section (Riverbed)		All sources are suitable for soling, however PN-4 is not suitable for dressed stones.	c. PN-4 can be used for soling stone subject to condition mentioned in Table 11.1.
PN-5	Hajira - Abbasspur - Haveli Section (Outcrop)			
PN-6	Jaboti-Ali Sojal Section(Outcrop) Shaheed Gala			
PN-7	Jaboti-Tolipeer Section(Outcrop)			

CONSTRUCTION MATERIAL SOURCES IN AND AROUND AZAD JAMMU & KASHMIR						
Table 16.19						
Plan for Construction Material Procurement for Buildings and Bridges in District Sudhnuti, AJ&K						
Aggregate Type	Recommended Usage with Ordinary Portland Cement (OPC)	Source Designation and Title		Proposed Service Area	Recommendations for Procurement of Coarse and Fine Aggregate	Action for Regularization in CSR
Coarse Aggregate	ALL PURPOSE USAGE RECOMMENDED for Public and Private Buildings and Cross Drainage Structures on Roads	P-1	Bakot Limestone	District Sudhnuti	1	a. Existing source located in Pakistan and designated as P-7 should be continued in the CSR as "Approved Source" in addition to P-1, BG-18 and BG-19.
		BG-18	Khurshidabad Limestone	District Sudhnuti		
		BG-19	Khurshidabad Dolerite	District Sudhnuti		
		P-7	Margalla Hill Limestone	District Sudhnuti	2	
		SD-9	Pappe Nar Sandstone(Outcrop)	District Sudhnuti		
		SD-10	Pappe Nar Sandstone(Outcrop)	District Sudhnuti		
		SD-11	Nar Brahmanan Sandstone(Outcrop)	District Sudhnuti		
	MARGINAL USAGE Recommended with Ordinary Portland Cement (OPC)	PN-1	Arja - Dalkot Section (Outcrop)	District Sudhnuti	3	b. Three (03) sources of material that exit within the district i.e., sources SD-9 to SD-11 are recommended to be regularize as marginal sources for low strength concrete in higher risk structures and medium strength concrete for low risk concrete refer Table 12.1. The sources PN-1 to PN-7(Poonch Districts) are recommended to be regularize as marginal sources for low strength concrete in high risk structures and medium strength concrete for low risk concrete refer Table 11.1.
		PN-2	Goi Nullah - Rawalakot Section (Outcrop)	District Sudhnuti		
		PN-3	Rawalakot - Khai Gala - Hajira Section (Outcrop)	District Sudhnuti		
		PN-4	Hajira - Abbasspur - Haveli Section (Riverbed)	District Sudhnuti		
		PN-5	Hajira - Abbasspur - Haveli Section (Outcrop)	District Sudhnuti		
		PN-6	Jaboti-Ali Sojal Section (Outcrop) Shaheed Gala	District Sudhnuti		
		PN-7	Jaboti-Tolipeer Section(Outcrop)	District Sudhnuti		
Fine Aggregate	ALL PURPOSE USAGE RECOMMENDED	P-8	Lawrencepur Sand	District Sudhnuti	4	c. Existing source P-8 should be retained in the CSR as "Approved Source" for all purpose usage. Lawrencepur filter material source is also recommended for filter media as per project specifications.

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Table 16.20

Plan for Construction Material Procurement for Roads in District Sudhnuti, AJ&K

Source Designation and Title		Material Usage	Recommendation for Procurement of Material	Action for Regularization in CSR
SD-9	Pappe Nar Sandstone(Outcrop)	1 Asphalt Aggregate	No source is suitable for asphalt aggregate.	<p>a. Existing source P-7 should remain be included in the CSR as an "Approved Source" for asphalt aggregate. New sources P-1, BG-18 and BG-19 should be added as approved sources.</p> <p>b. Three sources from Sudhnuti and all sources approved for Poonch district should be included in the CSR as "Approved Sources" for sub base material.</p> <p>c. Three sources from Sudhnuti and all sources approved for Poonch district should be included in the CSR as "Approved Local Sources" for Stone for Masonry and Soling Works</p>
SD-10	Pappe Nar Sandstone(Outcrop)	2 Base/ Sub Base	Allow use of material from all sources in Sub-base.	
SD-11	Nar Brahmanan Sandstone(Outcrop)	3 Stone for Masonry and Soling Works	Allow use of material for masonry stone and soiling stones from all sources.	

CHAPTER 17

CONCLUSIONS AND RECOMMENDATIONS

NESPAK completed the study as per the Terms of Reference and methodology finalized in consultation with the Working Group formulated by the Planning and Development Department, AJ&K. The study covers all districts, of the State. In addition, the study was also extended in the adjoining areas of Pakistan to make best use of the resources available in the vicinity in case of material short fall in the State.

Districts Muzaffarabad and Jhelum Valley, Bagh and Haveli are centrally located and quite resourceful with respect to availability of the construction material.

District Kotli is centrally located and quite resourceful with respect to availability of the construction material. However, districts Mirpur and Bhimber are deficient in good quality construction material fit for all purpose.

The Neelum district northerly located is quite resourceful with respect to availability of the construction material. However, districts Poonch and Sudhnuti are deficient in good quality and fit for all purpose construction material.

Important conclusions of the study and recommendations are summarized in the following sections.

17.1 Conclusions

Important conclusions of the study conducted in the AJ&K and adjoining area of Pakistan are given below:

17.1.1 District Muzaffarabad

- 1 Construction materials are being procured from various locations within the district; however, none of the sources is approved in the Composite Schedule of Rates (CSR). The only approved sources are in Pakistan including Margalla Limestone Quarry and Lawrencepur Sand Deposits.
- 2 Sixteen (16) sources were identified and studied in the district during the current study.
- 3 Seven (7) rock sources have been rated as suitable for quarrying coarse aggregate for producing (a) concrete of strength up to 2000 psi, 3000 psi and more, (b) asphalt road works, and (c) base/ sub-base road elements. These sources are located in the vicinity of Muzaffarabad city, Nauseri and Balgran etc. The rocks comprising these sources include limestone, dolomite, meta-sediments, metabasalt (Greenstone) and dolerite. These sources are also suitable for quarrying stone for masonry works.
- 4 Four (04) sandstone sources and one (01) nullah bed gravel source have been rated as suitable for quarrying stone for various masonry works and soling material for road works. These sources are located in Lamnian (Sundari Bandi), Komi Kot, Kohala, and Chatter Kalas.
- 5 Keeping in view the local scenario, safety and material requirements, the grey, strong small sandstone similar exposures of Murree Formation not fall in the source criteria have been rated as suitable for quarrying stone for various masonry works and soling material for road works at various localities of district Muzaffarabad.

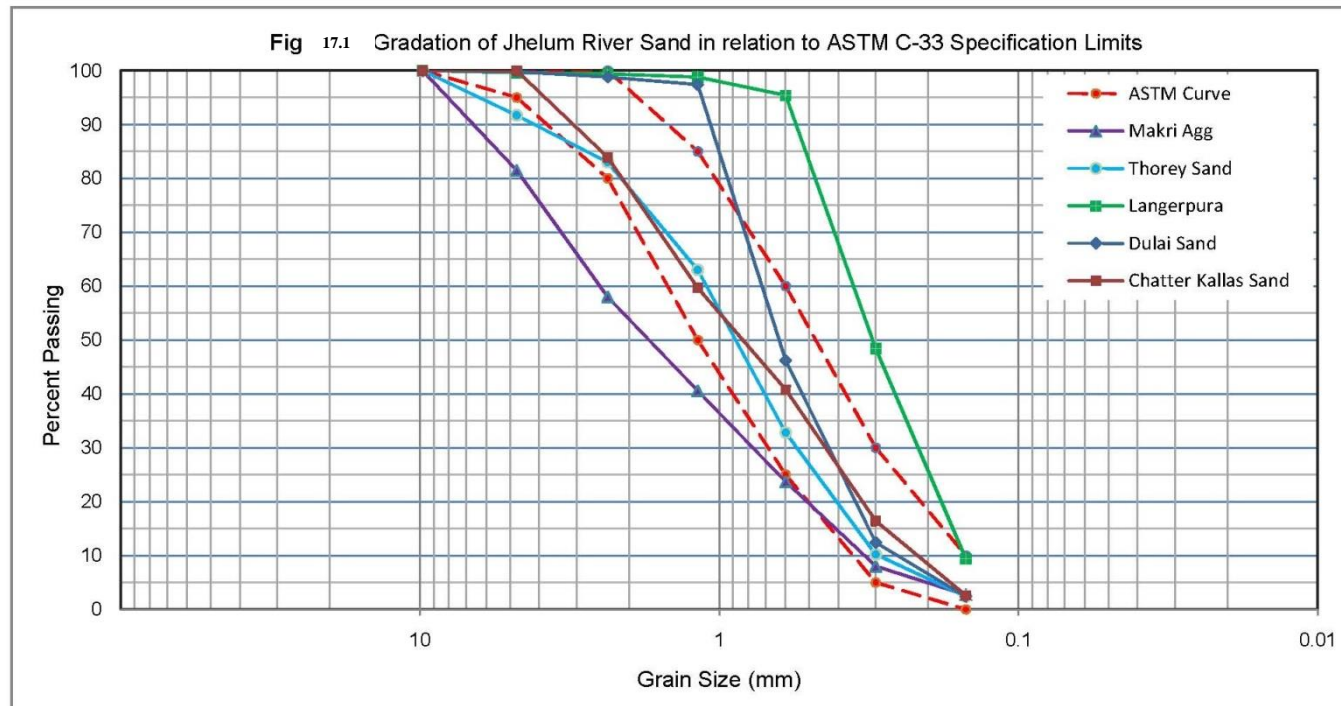
- 6 The local limited exposures of Murree Formation having characteristics similar to the identified sources, the recommendations presented in Table 5.1 for this material shall also prevail. Such material may encounter during road cutting and project excavations.
- 7 Five (05) river sand sources have been rated as suitable for low-strength concrete production. These sources are located near Challpani, Langarpura, Thori, Dulai, and Barsala. Refer correlation chart of local sand with ASTM standards curve are shown in **Figs.17.1 and 17.2.**
 - There is no source of sand in the district that is comparable to the quality of Lawrencepur Sand Deposits in Pakistan.
 - A source of naturally crushed dolomite in Muzaffarabad city; known as Makri Bela quarry and presently being quarried unofficially, is rated as posing serious risks to the life and property. A similar potential source in the vicinity near Showai is also discarded on the same account.
 - A gradual reduction in dependency on far off sources located in Pakistan for coarse aggregate is anticipated with the utilization of the identified sources in the district and in the adjoining areas.

17.1.2 District Jhelum Valley

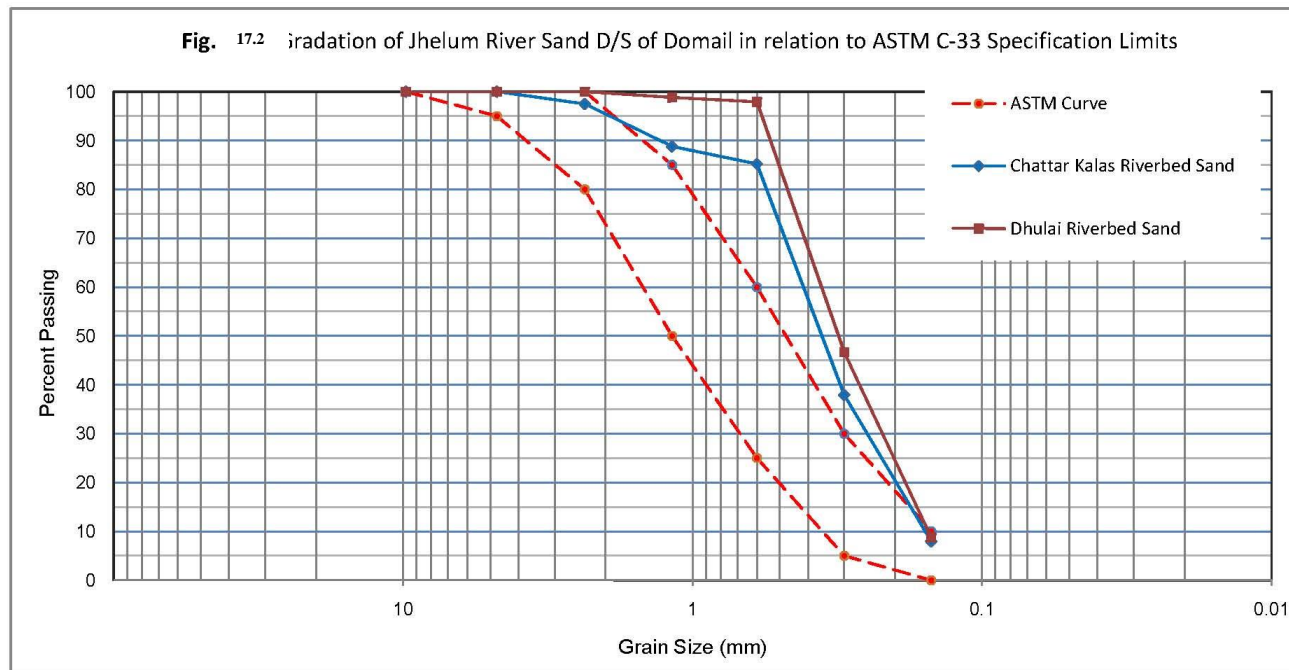
- 1 Construction materials are being procured from various locations within the district; however, none of the sources is approved in the Composite Schedule of Rates (CSR). The only approved sources are in Pakistan including Margalla Limestone Quarry and Lawrencepur Sand Deposits.
- 2 Eight (8) sources were identified and studied in the district during the current study.
- 3 Six (6) rock sources have been rated as suitable for quarrying coarse aggregate for producing (a) concrete of strength up to 2000 psi, 3000 psi and more, (b) asphalt road works, and (c) base/ sub-base road elements. These sources are located in the vicinity of Muzaffarabad city, Lamnian & Chakhama, etc. The rocks comprising these sources include limestone, dolomite, meta-sediments, metabasalt (Greenstone) and dolerite. These sources are also suitable for quarrying stone for masonry works.
- 4 One (1) sandstone sources and one (01) nullah bed gravel source have been rated as suitable for quarrying stone for various masonry works and soling material for road works. These sources are located in Lamnian (Sundari Bandi) and Chinari.
- 5 Keeping in view the local scenario, safety and material requirements, the grey, strong small sandstone similar exposures of Murree Formation not fall in the source criteria have been rated as suitable for quarrying stone for various masonry works and soling material for road works at various localities of district Jhelum Valley.
- 6 The local limited exposures of Murree Formation having characteristics similar to the identified sources, the recommendations presented in Table 5.1 for this material shall also prevail. Such material may encounter during road cutting and project excavations.
- 7 Five (05) river sand sources have been rated as suitable for low-strength concrete production. These sources are located near Challpani, Langarpura, Thori, Dulai, and Barsala. Refer correlation chart of local sand with ASTM standards curve are shown in **Figs.17.1 and 17.2.**
 - There is no source of sand in the district that is comparable to the quality of Lawrencepur Sand Deposits in Pakistan.

- A gradual reduction in dependency on far off sources located in Pakistan for coarse aggregate is anticipated with the utilization of the identified sources in the district and in the adjoining areas.

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CONSTRUCTION MATERIAL SOURCES STUDY IN AND AROUND AJK



17.1.3 District Bagh

- Construction materials are being procured from various locations within the district; however, none of the sources is approved in the Composite Schedule of Rates (CSR). The only approved sources are located in Pakistan that includes Margalla Limestone and Lawrencepur Sand.
- Twelve (12) sources are identified and investigated in districts Bagh and Haveli.
- No rock sources have been rated as suitable for quarrying coarse aggregate for producing (a) concrete of varying strength, (b) asphalt road works, and (c) base/ sub-base road elements.
- Five (05) riverbed gravel sources have been rated as suitable for borrowing coarse aggregate for producing (a) concrete of low-strength, (b) asphalt road works, and (c) base/ sub-base road elements. These sources are located within the beds of (a) Mahl River (b) Malwani Kas. The gravel and boulders of these sources mostly comprise of sandstone.
- Ten (10) sandstone sources have been rated as suitable for quarrying stone for various masonry works and soling material for road works. These sources are located throughout the tehsils of Dhirkot and Bagh.
- Keeping in view the local scenario, safety and requirements the similar grey, strong small sandstone exposures of Murree Formation not fall in the source criteria have been rated as suitable for quarrying stone for various masonry works and soling material for road works exposed at various localities of districts Bagh and Haveli.
- The local limited exposures of Murree Formation having characteristics similar to the identified sources, the recommendations presented in Table 6.1 for this material shall also prevail. Such material may encounter during road cutting and project excavations.
- There is no source of sand in the district that is comparable to the quality of Lawrencepur sand deposits in Pakistan.
- Dependency on the existing far off located sources in Pakistan can be gradually reduced with the utilization of local sources in the district as well as sources located in Muzaffarabad district.

17.1.4 District Haveli

- Construction materials are being procured from various locations within the district; however, none of the sources is approved in the Composite Schedule of Rates (CSR). The only approved sources are located in Pakistan that includes Margalla Limestone and Lawrencepur Sand.
- Nine (9) sources are identified and investigated in district Haveli.
- Only two (02) rock sources have been rated as suitable for quarrying coarse aggregate for producing (a) concrete of varying strength, (b) asphalt road works, and (c) base/ sub-base road elements. These sources are located in Khurshidabad, Haveli district. The sources include limestone and dolerite.

- Seven (2) riverbed gravel sources have been rated as suitable for borrowing coarse aggregate for producing (a) concrete of low-strength, (b) asphalt road works, and (c) base/ sub-base road elements. These sources are located within the beds of Palangai nullah and Betar Nullah near Betar. The gravel and boulders of these sources mostly comprise of sandstone.
- Keeping in view the local scenario, safety and requirements the similar grey, strong small sandstone exposures of Murree Formation not fall in the source criteria have been rated as suitable for quarrying stone for various masonry works and soling material for road works exposed at various localities of districts Bagh and Haveli.
- The local limited exposures of Murree Formation having characteristics similar to the identified sources, the recommendations presented in Table 7.1 for this material shall also prevail. Such material may encounter during road cutting and project excavations.
- There is no source of sand in the district that is comparable to the quality of Lawrencepur sand deposits in Pakistan.
- The Pozzolana Ash deposits are located near Kailer- Kahuta villages of district Haveli.
- Dependency on the existing far off located sources in Pakistan can be gradually reduced with the utilization of local sources in the district as well as sources located in Muzaffarabad district.

17.1.5 District Kotli

- Construction materials are being procured from various locations within the district; however, none of the sources is approved in the Composite Schedule of Rates (CSR). The only approved sources are located in Pakistan that includes Margalla Limestone and Lawrencepur Sand.
- Twenty-one (21) sources are identified and investigated in the district during the current study.
- Seven (07) rock sources have been rated as suitable for quarrying coarse aggregate for producing (a) concrete of strength up to 2000 psi, 3000 psi and more, (b) asphalt road pavement works, and (c) base/ sub-base road elements. These sources are located in Tatta pani, Sawar, Goi, Nikial and Khui Ratta. The rocks comprising these sources include dolomite.
- One (01) sandstone source has been rated as suitable for quarrying stone for various masonry works and soling material for road works. This source is located in Phawagri.
- There is no source of sand in the district that is comparable to the quality of Lawrencepur Sand Deposits in Pakistan.
- A gradual reduction in dependency on far off sources located in Pakistan for coarse aggregate is anticipated with the utilization of the identified sources in the district and in the adjoining areas.

17.1.6 District Mirpur

- Construction materials are being procured from various locations within the district; however, none of the sources is approved in the Composite Schedule of Rates

(CSR). The only approved sources are located in Pakistan that includes Margalla Limestone and Lawrencepur Sand.

- No bedrock exposure is found suitable for opening the quarry.
- Ten (10) nullahbed/ terrace gravel sources have been rated as suitable for borrowing coarse aggregate for producing (a) concrete of low-strength, (b) base/ sub-base road elements. These sources are located within the beds of various nullahs. The gravel and boulders of these sources mostly comprise of limestone and quartzite.
- There is no source of sand in the district that is comparable to the quality of Lawrencepur sand deposits in Pakistan. Refer correlation chart of local sand in main study area with ASTM standards curve are shown in **Fig.17.3**.
- The details of clay sources of district Mirpur for brick industry are given in Appendix-2.
 - Dependency on the existing far off located sources in Pakistan can be gradually reduced with the utilization of local sources in the district as well as sources located in Kotli.

17.1.7 District Bhimber

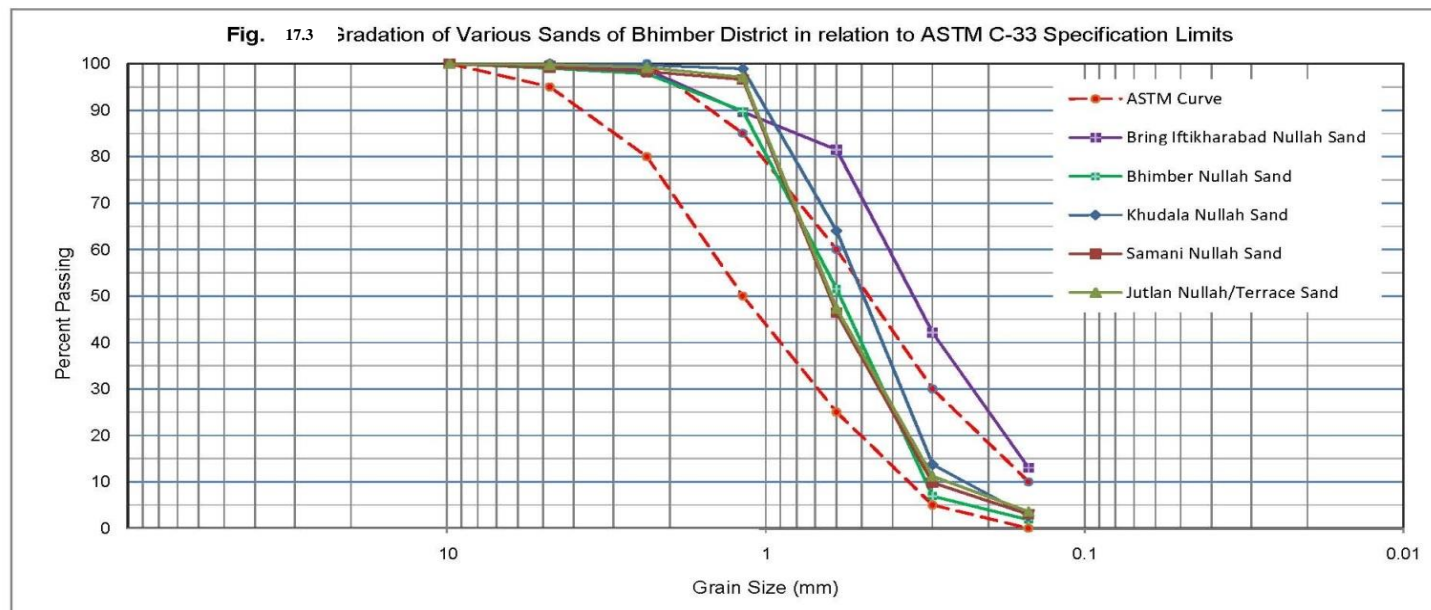
- Construction materials are being procured from various locations within the district; however, none of the sources is approved in the Composite Schedule of Rates (CSR). The only approved sources are located in Pakistan that includes Margalla Limestone Quarry and Lawrencepur Sand Deposits.
- No bedrock exposure is found suitable for opening the quarry.
- Three (03) river gravel sources have been rated as suitable for borrowing coarse aggregate for producing (a) concrete of low-strength, (b) base/ sub-base road elements. These sources are located within the beds of various nullahs. The gravel and boulders of these sources mostly comprise of mostly of limestone and quartzite. The gravel source is unsuitable for asphalt wearing course.
- There is no source of sand in the district that is comparable to the quality of Lawrencepur sand deposits in Pakistan. Refer correlation chart of local sand with ASTM standards curve are shown in **Fig.17.3**.
- The details of clay sources of district for brick industry are given in Appendix-2.
- Dependency on the existing far off located sources in Pakistan can be gradually reduced with the utilization of local sources in the district as well as sources located in Kotli.

17.1.8 District Neelum

- Construction materials are being procured from various locations within the district; however, none of the sources is approved in the Composite Schedule of Rates (CSR). The only approved sources are located in Pakistan that includes Margalla Limestone and Lawrencepur Sand.
- Thirteen (13) sources are identified and investigated within the district boundary during the current study.
- Five (05) rock sources have been rated as suitable for quarrying coarse aggregate for producing (a) concrete, (b) asphalt road works, and (c) base/ sub-base road

elements. These sources are located in Nauseri, Balgran, Dudhnial, Changan, and (Kharigam) Malik Seri. The rocks comprising these sources include Basalt, Dolerites, and Arenaceous Dolomite.

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- The Dolerites from Nauseri, Changan, and Malik Seri is found suitable for concrete aggregate. The same source is also suitable for the asphalt wearing course.
- The Basalt, Dolerites, and Metacarbonate sources has been rated as suitable for quarrying stone for various masonry works and soling material for road works. These sources are located in Nauseri, Dudhnial, Changan, and Malik Seri.
- There is no source of sand in the district that is comparable to the quality of Lawrencepur sand deposits in Pakistan. Refer correlation chart of local sand in main study area with ASTM standards curve are shown in **Fig.17.4**.
- A gradual reduction in dependency on far off sources located in Pakistan for coarse aggregate is anticipated with the utilization of the identified sources in the district and in the adjoining areas.

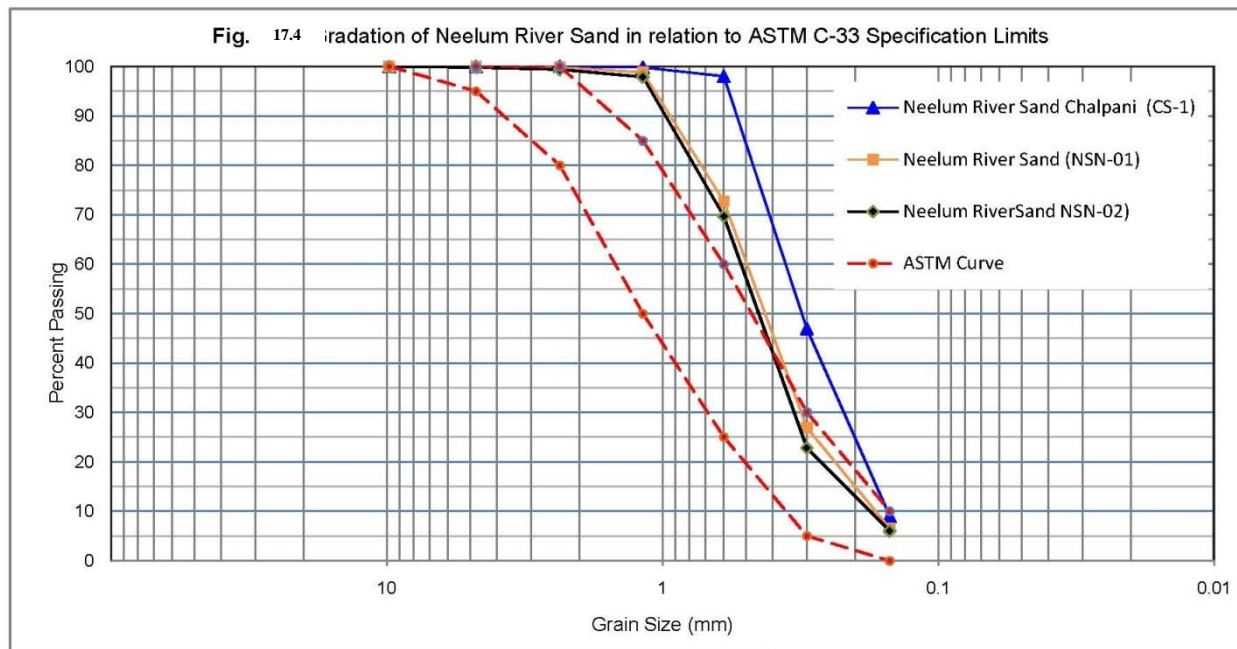
17.1.9 District Poonch

- Construction materials are being procured from various locations within the district; however, none of the sources is approved in the Composite Schedule of Rates (CSR). The only approved sources are located in Pakistan that includes Margalla Limestone and Lawrencepur Sand.
- Bedrock exposure is found suitable for opening the quarry. These sources have been rated as suitable for borrowing coarse aggregate for producing (a) concrete of low-strength, (b) base/ sub-base road elements and (c) stone for masonry.
- The nullah/ terrace gravel sources have been rated as suitable for borrowing coarse aggregate for producing (a) concrete of low-strength, (b) base/ sub-base road elements. These sources are located within the beds of various nullahs. The gravel and boulders of these sources mostly comprise of mostly of sandstone.
- There is no source of sand in the district that is comparable to the quality of Lawrencepur Sand Deposits in Pakistan.
- Dependency on the existing far off located sources in Pakistan can be gradually reduced with the utilization of local sources for marginal usage in the district as well as development of sources located in district Haveli.

17.1.10 District Sudhnuti

- Construction materials are not procured from any location within the district. The only approved sources are located in Pakistan that includes Margalla Limestone and Lawrencepur Sand.
- No bedrock exposure is found suitable for opening the quarry.
- No river/nullah gravel source has been rated as suitable for borrowing coarse aggregate for producing concrete, asphalt and base/ sub-base road elements. The nullahs gravel sources is unsuitable because of the Siwalik origin.
- There is no source of sand in the district that is comparable to the quality of Lawrencepur sand deposits in Pakistan.
- Dependency on the existing far off located sources in Pakistan will not be curtailed, due to material deficiency in the district. However, the marginal material from the

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- neighboring Poonch district may help procuring material for low strength concrete in structure of less life rick, road aggregate other than asphalt layer, stones and soling.

17.1.11 Adjoining Areas in Pakistan

- Eight (8) sources are identified and investigated within the adjoining area in Pakistan.
- Four (4) additional sources for coarse aggregate have been identified in Pakistan but at much closer distances as compared to the Margalla Quarry. The transportation cost has reduced to about one third level which will provide substantial benefits to the State exchequer.
- A huge new source of coarse aggregate is identified just at a distance of six (6) km from the Kohala in District Abbottabad. This source is recommended for development on priority from where material can be provided to Muzaffarabad and Bagh.
- Two river gravel sources are identified and investigated within the adjoining area in Pakistan. These gravels have similar composition and properties as of the upstream areas in AJ&K.
- No alternate for Lawrencepur Sand Deposits is identified in adjoining area, except the Chenab sand. This sand does not qualify the ASTM C-33 limits. However, blending of Chenab sand and rock dust of appropriate sizes can be a viable option.

17.2 Recommendations

Important recommendations based on the above conclusions about material sources in the districts of AJ&K and adjoining area of Pakistan are given below:

- All existing and new sources having suitable material should be included in the Composite Schedule of Rates as “Approved Sources” for the recommended uses. The new sources should be leased and developed.
- The sources posing risks to the life and property should be banned.
- The study findings should be circulated to all the stake holders in private as public sector.

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