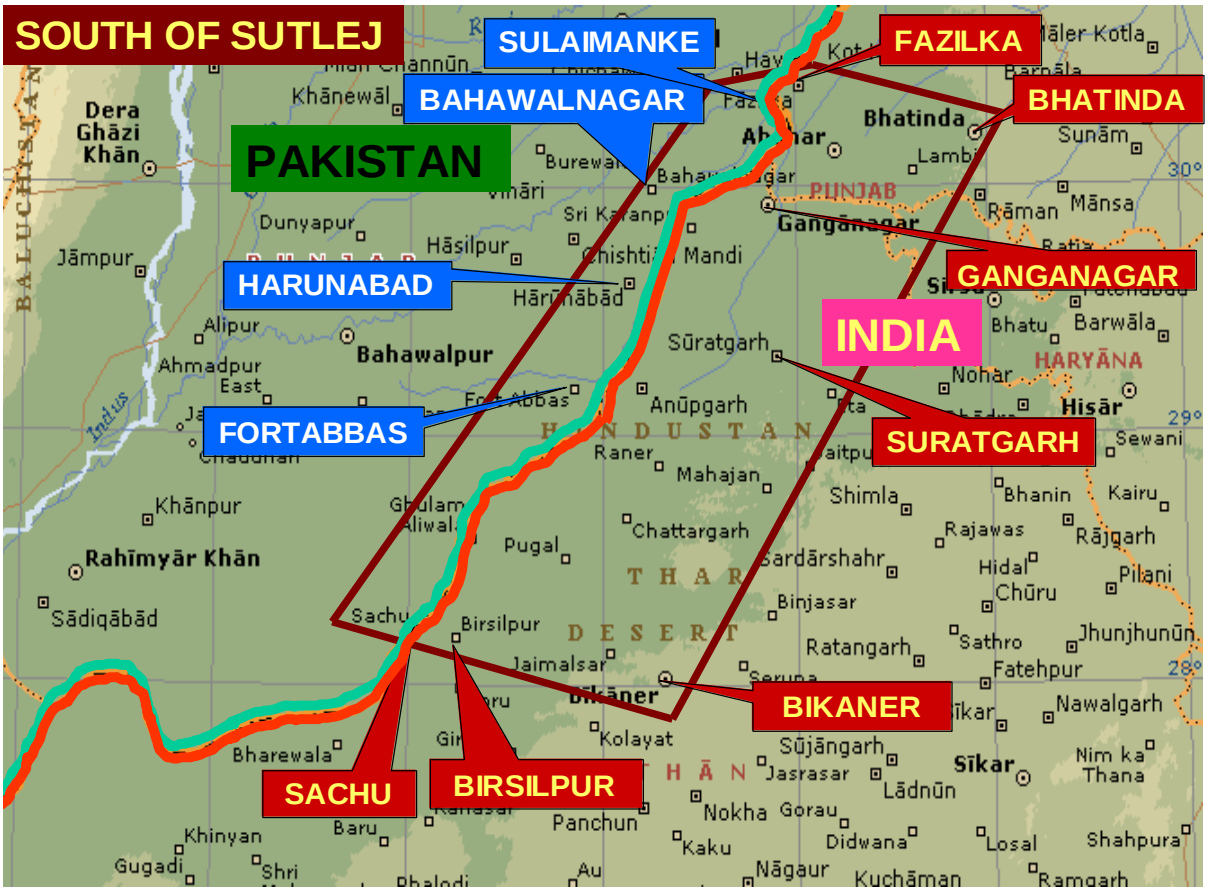
PART I
TERRAIN PROFILE

SECTION - 1 – GENERAL

1. **General**. This study encompasses the known changes, developments and improvements that have taken place in the sector upto December 2007. The sector



stretches east of line Sulaimanki Headwork and Fort Abbas. On the Indian side, it includes the South West portion of Punjab and North West portion of Rajasthan province. The length of the area is about 375 kilometres, whereas the depth varies from 80 to 120 kilometres. It has a common boundary with Pakistan for its entire length. The area of the study is bounded as indicated below :-

a. North - Fazilka - Bhatinda
b. West - Indo - Pakistan border
c. South - Sachu - Bikaner
d. East - Bhatinda - Ganganagar - Suratgarh - Bikaner

2. **Scope of Study.** The study encompasses fol: -

a. Topography, Climate and Vegetation.
b. Communication Infrastructure / Logistic Installations.
c. Obstacles.

d. Logistic problems.

e. Military Analysis of Area.

3. **Sources of Information.** Information included in the study is based on HUMINT and ELECINT, In addition following resources have been utilized: -

a. **Maps**

Serial	Maps	Sheet Nos
(1)	1:1,000,000	NH 42,43,NG 42 and 43
(2)	1:250,000	39 P,40 M, 44 C,D,F,G,H, J,K&L. 44 C, F,G, J and K 45 A and E.
(3)	1:50,000	39 P/16, 44 C/16, 44 D/2 to 13. 44 F/12, 5 and 16 44 G/2 to 16. 44 H/1 to 16 44 J/3,4,7, 8, 11,12,15 and 16 44 K/1,2,3,4,5,9 and 13 44 M/13. 45 A/1,5,9 and 13.45 E/1 and 5

b. **Air Photographs**. Details of air photographs used are as under: -

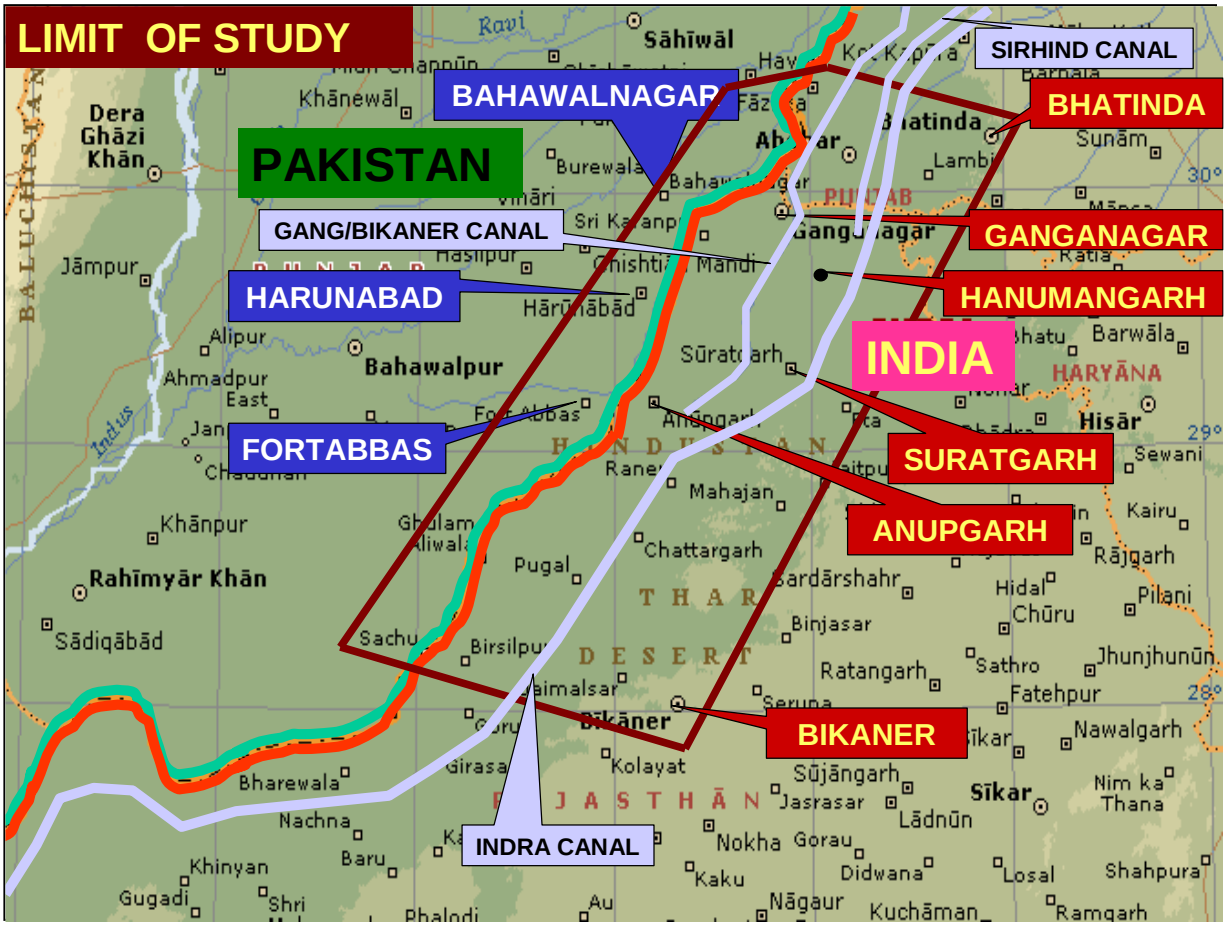
	Sortie	Area Coverage
(1)	5S/L/122/95 dated 13 Jun 95	Ghulam Ali Wala to Qabul Shah
(2)	5S/L/284/95 dated 5 Nov 95	Charan Wala to Hisamki
(3)	5S/L/77/96 dated 23 Apr 96	Ranjitpura to Hisamki
(4)	5S/L/78/96 dated 23 Apr 96	Bhayhan Wala to Fazilka
(5)	5S/L/112/97 dated 6 May 97	Rajhri to Charan Wala
(6)	5S/L/235/98 dated 28 Oct 98	Anarwala to BP-542
(7)	5S/L/236/98 dated 29 Oct 98	Beriwala to Ramkot
(8)	5S/L/237/98 dated 29 Oct 98	Khyowala to Fazilka
(9)	5S/L/53/99 dated 20 Apr 99	Siasar to Qabul Shah
(10)	5S/L/56/99 dated 21 Apr 99	Sakhi to Ranjitpura
(11)	5S/L/50/2000 dated 11 Apr 00	Karni Khara to Lal Pura
(12)	5S/L/53/2000 dated 12 Apr 00	Chak 7812 to Ranjitpur
(13)	5S/L/163/03 dated 11 Nov 03	Sataiyana to Ahmedwala Khu
(14)	5S/L/177/03 dated 20 Nov 03	Chuharanwala to Chak 281HR

c. **Satellite Imageries**. About 269 imageries of 1 Meter resolution (IKONOS) cover the area falling in this sector. One Compact Disk containing coverage of the area in its original form and annotated form has already been issued

SECTION - 2

TOPOGRAPHY, CLIMATE AND VEGETATION

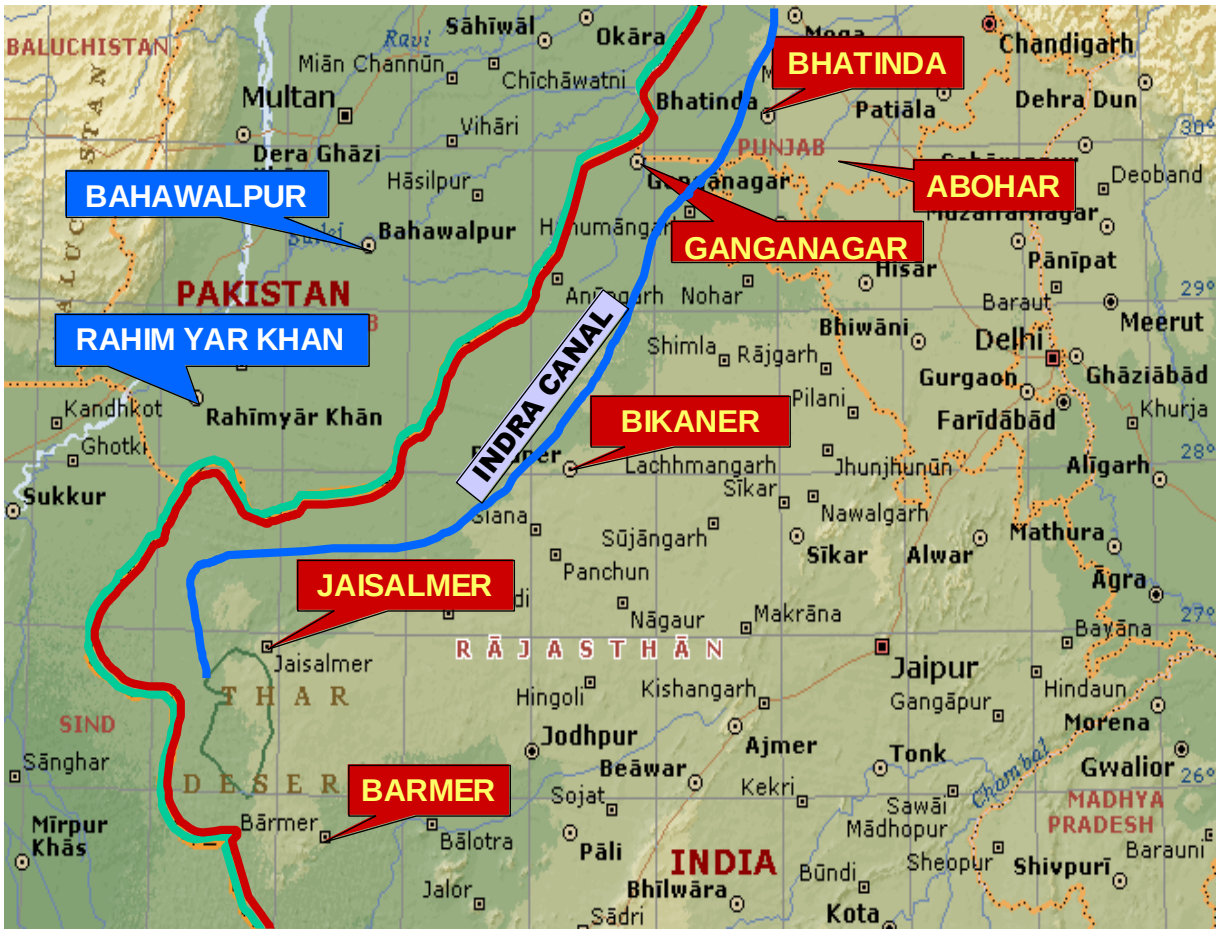
4. **General**. The area covered in the study generally lies opposite to Bahawalpur Division and conforms to districts of Bhatinda, Ganganagar, Hanumangarh, Suratgarh, Anupgarh and Bikaner. The general lay of the ground is



from South West to North East (Annexure P). The water channels in the area flow from north to south and North East to South West direction. The area is irrigated by Gang, Eastern, Bikaner, Sirhind and Indra Canals. It is one of the most fertile areas of India. Its southern end merges with Rajasthan, which is covered by vast stretches of sand. The area is served with well laid out communication network. Indians have elaborate plans for development of the area and have considerably improved the road / railway communication infrastructure, especially the areas close to the border.

5. **Topography**. The ground is generally plain, open, dry and sandy. Its northern and western portions are well irrigated and have plenty of trees and vegetation like plains of Punjab. India is trying to development the area as she intends converting the wasteland and the desert of Rajasthan into cultivated land. Most of the area of northern Rajasthan has already been brought under cultivation by

constructing Indra Canal. The impact of this development is being felt gradually, as new villages / towns are coming up, means of communication are being improved



and a sizeable population is migrating to these areas. The western Rajasthan is not covered by sand dunes and has been sub divided into several natural regional belts. The western region of this belt is covered by sand dunes and runs along Indo-Pakistan border. Next to this belt is the rocky area of Barmer and Jaisalmer.

6. **Lay of Ground**. The area is generally low lying and slopes westward to the Indus Basin and south ward to the Run of Kutch. The undulation varies from 90 to 450 metres Above Mean Sea Level.

7. **Soil**. It is sandy loam having grey or brown colour, and is absorbent in nature. The area is very dry and dusty in dry season. Cross-country movement for wheeled vehicle is slow and difficult. After rain, the ground becomes hard and compact, facilitating all types of movement.

8. **Water Table**. The water table is generally low. It varies from 3 to 4.5 metres in the north near Hindumalkot, to about 27 metres near Anupgarh. Sub-soil water level east of line Ganganagar-Suratgarth is from 45 to 60 metres. It is however, likely to improve with the improvements in irrigation system in the area. Water is generally

unfit for human consumption. However, water available at the depth of 90 to 180 metres is potable and fit for human consumption.

9. **Climate**

a. **Seasons**. The climate is similar to one prevailing in the adjoining areas of Bahawalpur Division of Pakistan. It is extremely hot in summers and moderate in winters. In Rajasthan, sand storms blow frequently and their intensity increases in April-June. Following seasons generally prevail in this sector:-

(1) **Autumn**. The season lasts from October to November. During this season, visibility is good and sky remains clear. There are hardly any rains and temperature remains moderate.

(2) **Winter**. This season lasts from December to February, wind is generally light and sky remains clear. Day temperature is pleasant but nights are very cold.

(3) **Spring**. It lasts from March to mid April. The temperature remains moderate and pleasant. Rains are scarce and light wind / dust storms effects visibility considerably.

(4) **Summer**. It commences from mid April and lasts until the end of September. It accounts for almost all the rains in the region. Dusty winds and storms are common features, which results in reduction of visibility. Temperature is extremely high during day but moderate at night.

b. **Temperature**. This is a region of extreme temperature. The variation between day and night temperatures in Rajasthan is so acute that mean value conveys an incorrect picture of actual temperature. During summers, the temperature rises up to 50^0 C but the nights are cool. During winters, day temperature ranges upto 35^0 C and night becomes so cold that some times frost occurs.

c. **Rainfall**. The rainfall is light and erratic. It mainly occurs during monsoon i.e from July to September. The annual rainfall varies from 7.6 centimetres to 20.3 centimetres in Bikaner District and 20.3 to 30.5 centimetres in Anupgarh District. In most of the desert belt of Thar and Bikaner maximum annual rainfall is 10 centimetre (average). There is a great variation of rainfall, so, it is completely undependable for

cultivation. Due to scanty rainfall, humidity is extremely low which results in dust storms.

10. **Vegetation**. The soil survey has shown that the area was capable of yielding good crops provided water was available; this resulted into the construction of Indra Canal. East Punjab area in the North East of this sector was well irrigated by Sirhind Canal and Sirhind Feeder and area east of Gang Canal is being irrigated by water from Indra Canal, so cultivation in this entire area is coming up very well. The extent of development in agriculture can be guaged by big agricultural farms that have come up recently. There are two seasons for cultivation in this area. The summer cultivation season 'Kharif' produces pulses, maize, bajra, cotton, sugar cane and mustard. The sowing is done in May / June and harvesting in October / November. The winter cultivation season 'Rabi' produces wheat, barley, mustard and fodder. The sowing is done in November / December and harvesting in April and May. After harvesting, the country side becomes bare, offering little cover for military operations.

11. **Agricultural Farms**. To boost agriculture and to improve varieties of seeds, India has set up agricultural farms. Two of the state owned farms in this sector are: -

a. **Suratgarh**. A state run farm spread over an area of 12,000 hectares. Russia has provided the farm with a fleet of 103 tractors, 40 harvesters and various types of other modern machines for farming and with foundry for its maintenance. This is the biggest state farm in the country.

b. **Jetsar (West of Sarupsar)**. The second biggest state farm is located in Ganganagar District and is spread over an area of about 12,000 hectares. Russia has provided a fleet of 30 tractors, 3 harvesters and other machinery like cranes, dozers and graders etcetera.

12. **Forests**. Palm and Shisham trees are found at number of places. Area close to the old bed of River Ghaggar is well forested. Hanumangarh is surrounded by forest on three sides i.e. east, west and north. Area close to Anupgarh also has forests. Clumps of trees are also found near Built up areas along roads and water channels. Extensive efforts are being made to increase plantation and other vegetation in the southern area. Forests and tree lines, around the cultivated fields are encouraged as they serve as windbreakers and check the high winds velocity and sand storms.

SECTION - 3

COMMUNICATION INFRASTRUCTURE AND LOGISTIC INSTALLATIONS

13. **General**. The communication system of Rajasthan province was under development before independence. There have been major improvements consequent to the new settlements and with the area being brought under cultivation. After Indo-Pakistan war of 1965, India constituted Border Roads Development Board, which is responsible for planning, execution and supervision of construction of roads. Keeping in view the tactical and strategic requirements, the efforts for construction and development of the border roads and tracks have been pronounced, significant developments and improvements in communication have taken place in last 8-10 years. The area is plain and cross country, movement is generally possible. The existing network of metalled and unmetalled roads is well maintained.

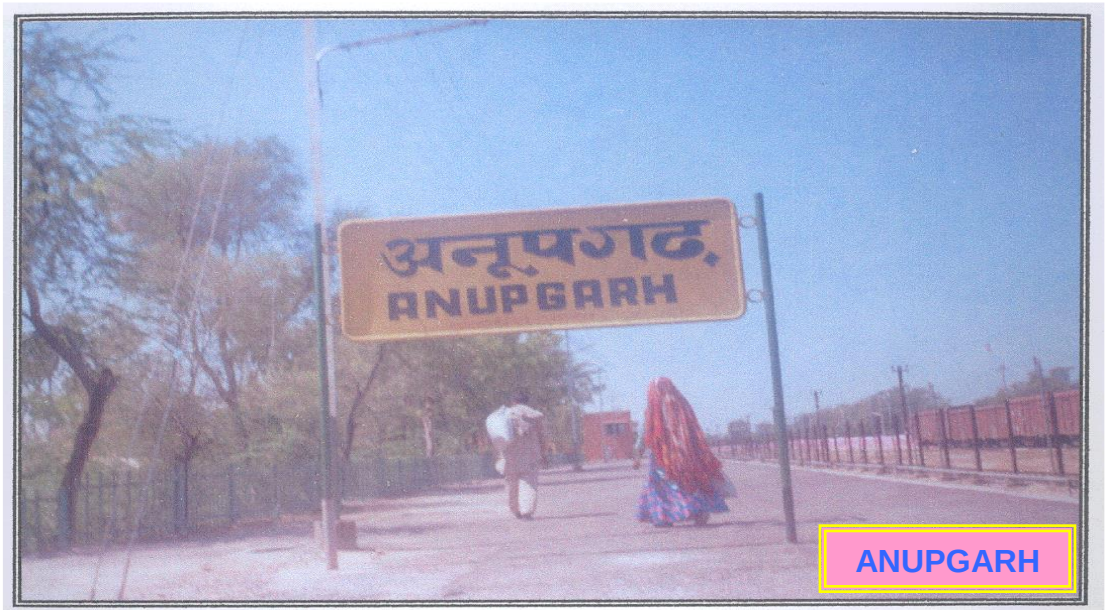
14. **Roads**. Roads have been constructed on sandy soil / rocky beds and can take heavy loads for limited period. Fair weather tracks in the area cannot sustain traffic for longer duration. Cross-country movement is possible but at some places, loose sand impedes traffic. Bridges are constructed on most of the dry gaps and construction of diversions is possible at these sites. Details are as under:-

a. **Penetrants / Laterals**. Annexure A and S.

b. **Bridges**. Details of major bridges in this sector are at Annexure B.

15. **Railways**. Details of railway in this sector are at Annexure B and S.

a. **Railway Bridges**. Details of railway bridges in this sector are at Annexure B.



b. **Railway Stations and Loading Ramps**. Annexure B.

c. **Railway Distances and Travelling Time**. Annexure B.

16. **Air Fields / Air Strips / Helipads**

a. **Air Fields (Transfrontier)**. (Annexure C). Important Airfields in this sector are as under:-

(1) **Sirsa Airfield**. It is an all weather Airfield fit for heavy / Jet aircraft. It is located at about 3.2 Kilometres northwest to Sirsa town. Nearest railway station is Sirsa. Air field is located in depth but can influence operations in the area.

(2) **Suratgarh Airfield**. It is an all weather Airfield fit for Jet aircraft.

(3) **Hissar Airfield**. It is a fair weather Airfield capable for non-jet / light aircraft.

(4) **Bhatinda Airfield**. A civil airfield, suitable for medium type of transport and jet aircraft. It has two runways. A mobile radar station is located at 1.6 kilometres north of Bhatinda Cantonment.

(5) **Bikaner Airfield**. It is an all weather airfield suitable for Jet aircraft. It is located at 19 kilometres west of Bikaner.

(6) **Hanumangarh Airfield**. It is an all weather Airfield suitable for Jet aircraft. Length of its runway is 2743 metres.

(7) **Mahajan Airfield**. It is an all weather Airfield suitable for Jet aircraft. It has 2743 metres length of runway.

(8) **Lalgarh Airfield**. It is an all weather Airfield suitable for Jet aircraft. It has 2743 metres length of runway.

(9) **Chhattargarh Airfield**. It is an all weather / Airfield suitable for Jet aircraft.

b. **Air Strips**. Details of air strips in this sector are at Annexure C.

c. **Helipads**. Annexure C.

17. **Communication Centres / Built up Areas**

a. **Transfrontier**. Details of major communication centres are as under: -

(1) **Ganganagar**. An important communication centre in this sector and District Headquarters of Ganganagar District. It is situated at 19 kilometres from the border. The town is protected in the west by Ganganagar Distributary and in the east by Gang Canal. Built up Area covers an area of about 20 square kilometres.

(2) **Anupgarh**. It is an important border town. A broad gauge railway line terminates at this town. It can be by-passed from any direction. Gang Canal tails off at 3.2 kilometres south of this town.

(3) **Raisinghnagar**. It is a small town located close to the border. It is well linked up with the hinterland by roads and railways.

(4) **Suratgarh**. An important railway junction and communication centre. The town is coming up rapidly. A new cantonment (Air Force Base) with an all weather jet capable Airfield has been constructed. It has a big workshop and foundry for a very large fleet of Russian Supplied tractors and other agricultural machinery. The area covered by the town is about 10 square kilometres.

(5) **Hanumangarh**. An important road communication centre located in depth. Hanumangarh railway station is located about 6.5 kilometres North West of the city. Forests are located in the east, north and west of the town. Northern and Southern Ghaggar Canals terminate in the vicinity of this town. It covers the area of about 4.6 square kilometres.

(6) **Bikaner**. It is important communication centre and District Headquarters. It is well connected with the surrounding areas by road, railway and air. There is a big cantonment situated in east of the town along the Road Delhi - Agra, comprising permanent single and double storey barracks for troops.

b. **Cisfrontier**. Following are the communication centres in this sector: -

(1) **Sahiwal**. It is a District Headquarters and major city in the area. It is connected by National Highway Lahore - Multan. It is also connected with all major towns / villages around, through metalled roads / kutcha tracks. Civil facilities of hospital, grid station, water reservoir, post and telegram office, railway and police stations and airstrip are available.

(2) **Chicha Watni**. This is a major town in the area. It is a Tehsil Headquarters of Sahiwal District, connected by both Road and Railway Line Lahore – Multan. All the villages around are connected through roads / tracks. Facilities of hospital, grid station, post and telegrams office, railway and police stations, telephone exchange and water reservoir are available.

(3) **Okara**. It is a District Headquarters connected with all major cities / towns / villages both by railway and road. Facilities of hospital, grid station, post and telegram office, railway and police stations, telephone exchange and water reservoir are available.

(4) **Pakpattan**. It is a District Headquarters and is linked with all cities / towns with roads / tracks. Grid station, post and telegram office, railway and police stations, telephone exchange and water reservoir are available.

(5) **Bahawalnagar**. It is a large size city and is a District Headquarters. All metalled roads in the area converge to Bahawalnagar. All facilities of urban city are available.

(6) **Fort Abbas**. It is medium size town with civic amenities and adequate water resources. It is an important communication centre as it is connected with high speed avenue Chishtian and Bahawalnagar. It is also connected by a metalled road with Marot.

(7) **Bahawalpur**. It is District Headquarters which has all the civic amenities available in urban centres. Numbers of routes are available through city and diversions; by passing is possible.

c. **Transfrontier Cantonments**. Annexure D.

18. **Logistic Installations**

a. **Supply Depots**. Annexure E.

b. **Petrol Oil Lubricant Depots**. Annexure E.

c. **Ammunition Depots.** Annexure E.

d. **Oil Pipe Line**. There is only one pipeline, which originates from Kandla and terminates at Bhatinda; it enters this sector at Rawali. Total length of this pipeline is about 1463 kilometres and it has a capability of about 6 millions tons of oil per day.

19. **Miscellaneous**

a. **Power Houses / Grid Stations**. Annexure F.

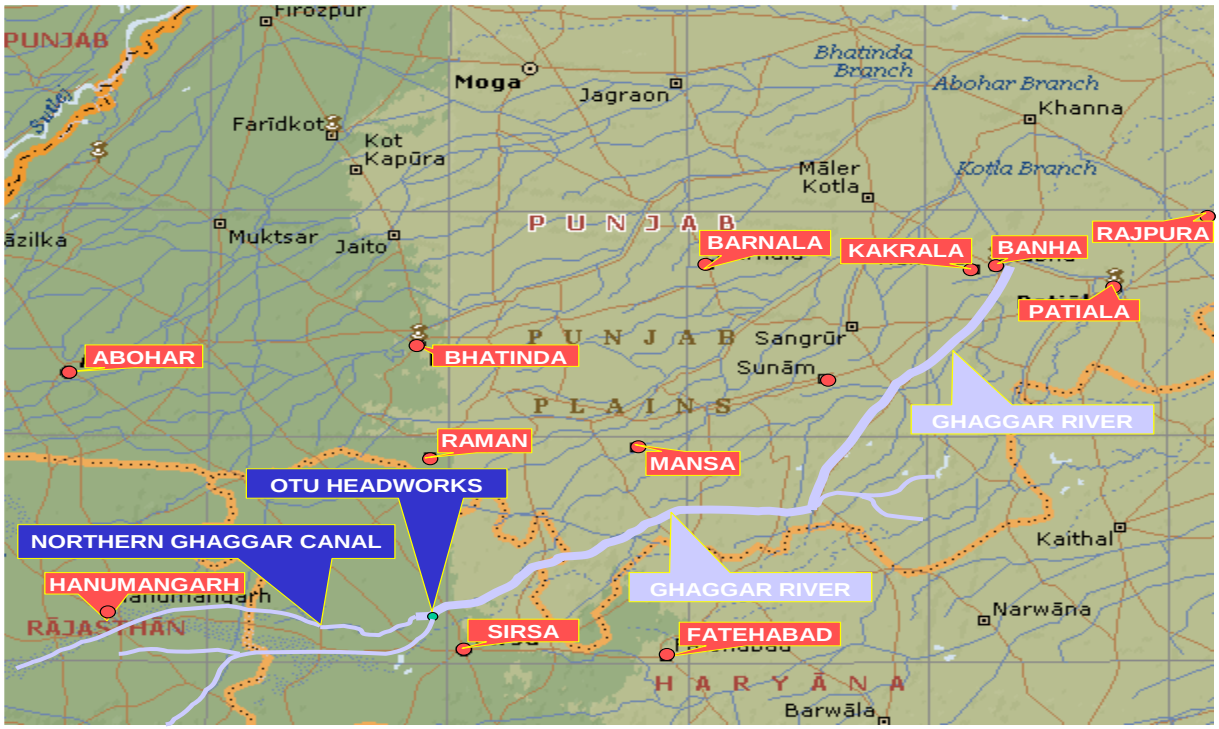
b. **Water Tanks**. Annexure F.

SECTION - 4

OBSTACLES

20. **General**. There is a network of canals and distributaries in the area, most of the water channels flow in North East to South West direction. These water obstacles have lot of military importance as they canalize the movement. The level of water in these channels begin to rise by end March and it is maximum in July / August and starts receding in September.

21. **Rivers**. Ghaggar is the only river in this sector. It originates from the slope of

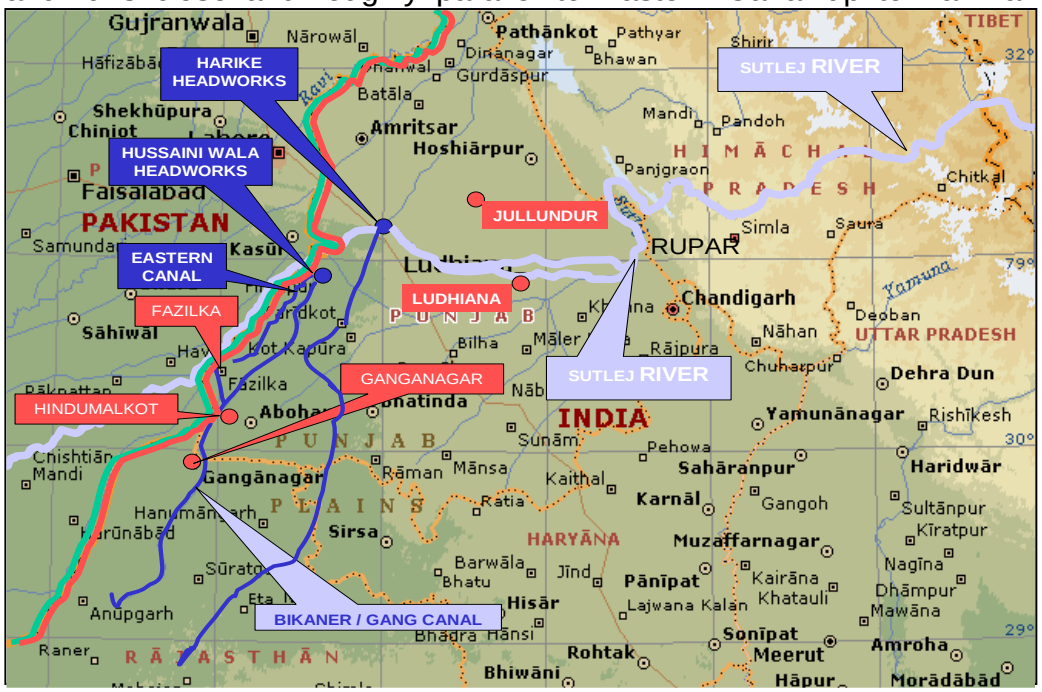


Siwalik Hills and after traversing through Patiala and Hissar Districts enters Bikaner Division of Rajasthan State from North East. Presently it is not more than a seasonal nullah in size. The alignment of the River is shown at Annexure Q. Two canals i.e.,

Northern Ghaggar Canal and Southern Ghaggar Canal have been taken out from this River. Sirhand Canal feeds this River in dry season. Since the River used to flood large area of Bikaner in wet period, so a diversion channel has been dug to divert the water to existing depressions near Suratgarh. This channel crosses Indra Canal through two siphons. The depressions near Suratgarh provide water for irrigation to model agriculture farms those have come up in Suratgarh.

22. **Canals**. Details of canals are as under (Refer Annexure G & Q): -

a. **Bikaner / Gang Canal**. It originates from Hussainiwala Head Works and runs close and roughly parallel to Eastern Canal up to Fazilka



where the later terminates. It enters Ganganagar District of Rajasthan near Hindumalkot. Detailed data is as under: -

(1) **Capacity**. It is fed by Hussainiwala Head Work, additional requirement of water is met by Ferozepur feeder. Total capacity of this Canal is 2720 cusecs.

(2) **Width and Depth**. Dimensions of the Canal varies as under:-

(a) 24 metre wide and 5 metre deep near Ganganagar.

(b) 12 to 13.5 metre wide and 4.2 metre deep in east of Rai Singhnagar.

(c) Width and depth reduces gradually towards the tail end.

(3) **Main Branches / Distributaries**. Number of distributaries take off from this Canal and irrigate area west of it up to Indo-Pakistan Border. Lalgarh Distributary takes off from this Canal at RD 1159

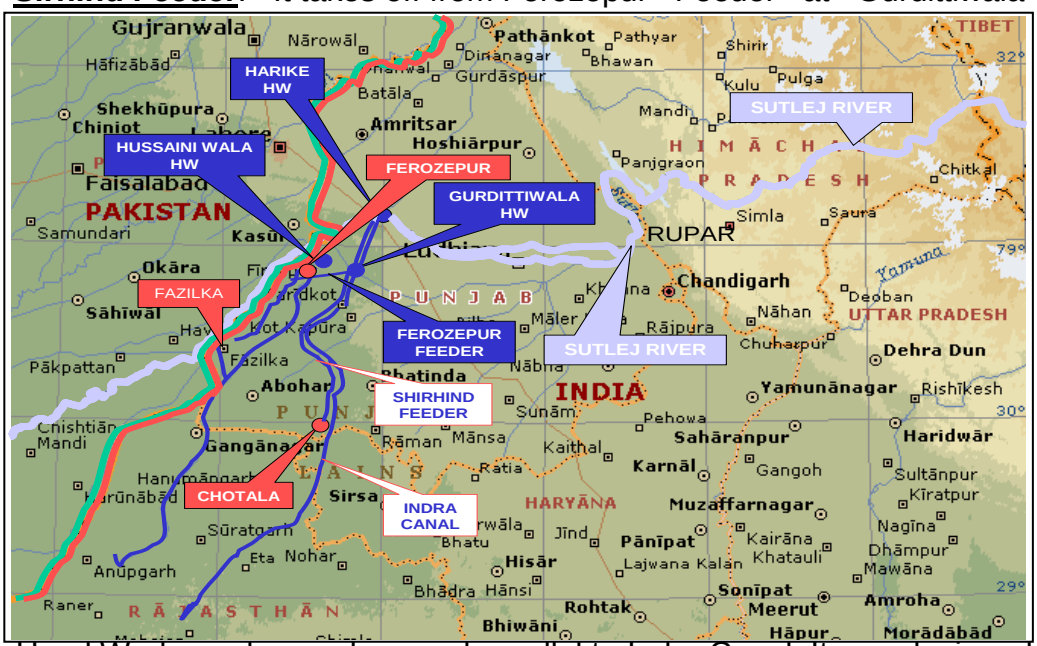
(44 F/16) and flows east and roughly parallel to it. It irrigates some area east of this Canal.

(4) **Lining**. To prevent the seepage main Canal is totally lined with locally available lime. The Distributaries are mostly unlined.

(5) **Service Road**. It has a service road, which runs along its Western bank.

(6) **Banks**. The banks are raised and have good vegetation.

b. **Sirhind Feeder**. It takes off from Ferozepur Feeder at Gurdittiwala



Head Works and runs close and parallel to Indra Canal. It was designed primarily to feed Sirhind Canal. However, it was extended up to Chotala to feed the Indra Canal so that the latter could be used for irrigation even before it was completed in the upper region. Details of this Feeder are as under: -

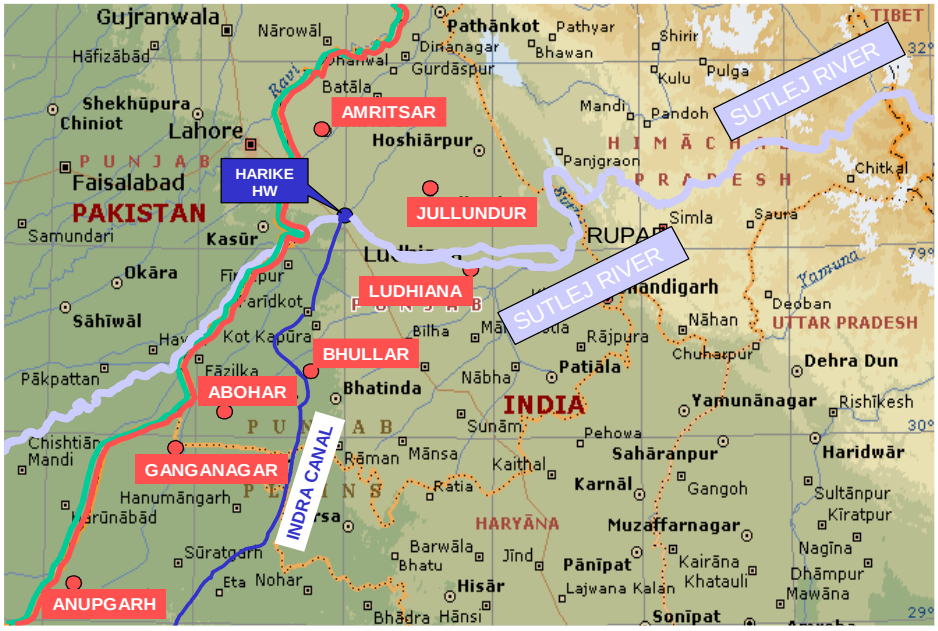
(1) **Capacity**. 4762 cusecs.

(2) **Width and Depth**. 15 to 21 metre wide and 4.3 metre deep.

(3) **Service Roads**. Both the banks have service roads.

c. **Indra Canal**. Imagery showing alignment of some portion of it is given at Annexure R. Details pertaining to Indra Canal are: -

(1) Indra Canal Project was conceived in October 1948 to irrigate millions of acres in Rajputana Desert. In order to utilize the flow of Beas River, new Head Works on the river were required. The simplest and cheapest solution was to construct new Head Work



at Harike Barrage just below the junction of Sutlej and Beas Rivers. The Harike Barrage was constructed in 1951-53 as Partition in 1947 caused division of Indus Basin Rivers and separation of the world's largest integrated gravity flow irrigation system. The Indus Water Treaty (19 September 1960), primarily designed to resolve the division of water. It allocates Eastern Rivers (Sutlej, Beas and Ravi) to India and Western River (Indus, Jhelum and Chenab) to Pakistan. The Indra Canal was the king pin of India's case for additional usage of water from the Indus basin . Indus Water Treaty opened the way for development of barren land (Rajasthan) through water of Ravi and Beas Rivers. The work on Indra Canal project was undertaken in March 1958.

(2) The purpose of Indra Canal was to provide irrigation facilities to the Thar Desert and drinking water to districts of Rajasthan, Ganganagar, Bikaner, Jaisalmer, Jodhpur & Barmer. The Indra

Canal was re-named as Indra Gandhi Canal. It takes off from Harike Head Works and flows in South / South West direction. It is the longest irrigation unit of the world. It acts as feeder for 204 kilometres of length i.e. 169 kilometres in Punjab, 14 kilometres in Haryana and 21 kilometres in Rajasthan and then proceeds as canal for 445 kilometres. The total length is 649 kilometre. Construction work of the canal was planned in two stages, Stage I has been completed and the work on Stage II is in progress. Indra Canal enters this sector near Bhullar (GR 7503-44 J/11) and irrigates the area near Phulsar (GR 7630-45 A/5).

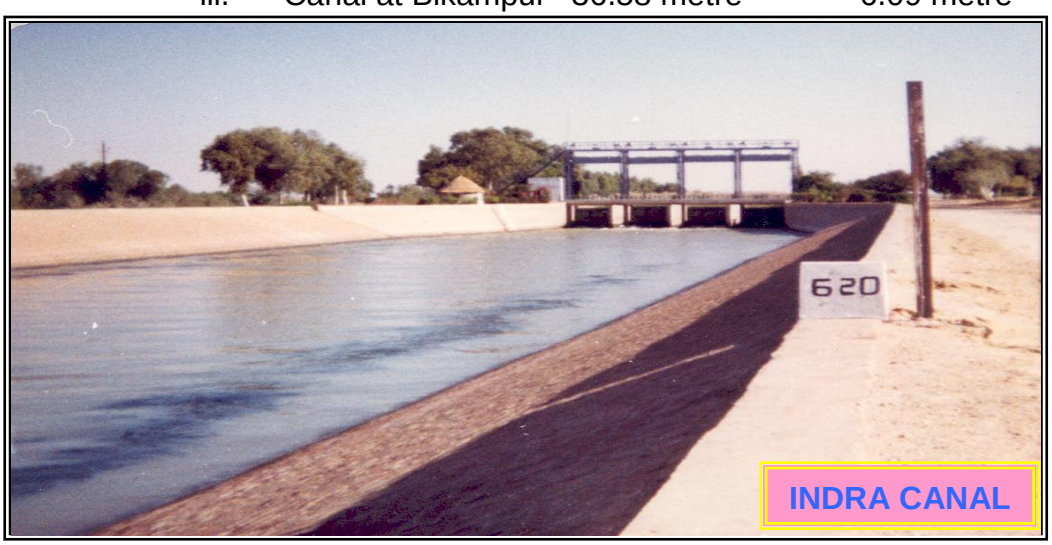
(3) **Salient Features**. Salient features of the Canal are as under:-

(a) **Alignment**. The Canal flows through Punjab for 1279 kilometres and then enters Rajasthan. Detailed alignment is attached at Annexure Q.

(b) **Capacity**. At head regulator its capacity is 18500 cusecs.

(c) **Dimensions**. The dimensions of the Canal are:-

		Width	Depth
i.	Feeder at Harike	38 metre	8.64 metre
ii.	Canal at Rawatsar	36.58 metre	6.4 metre
iii.	Canal at Bikampur	36.58 metre	6.09 metre



(4) **Canal**. Dimensions of the head and feeder are same but once it starts feeding various sub-branches / distributaries, the width and depth reduces gradually.

(5) **Lining**. The Canal is brick lined throughout its length.

(6) **Banks**. Banks are 4.5-6 metres high and width at the base is 45-48 metres.

(7) **Escapes**. In the absence of suitable outfalls for escapes, India has developed available depressions as small inland lakes, which can also be used as fish farms. It is believed that Phidda Outfall Drain, Chand Bhan drain and Ghaggar Channels have been improved mainly as escapes for Indra Canal.

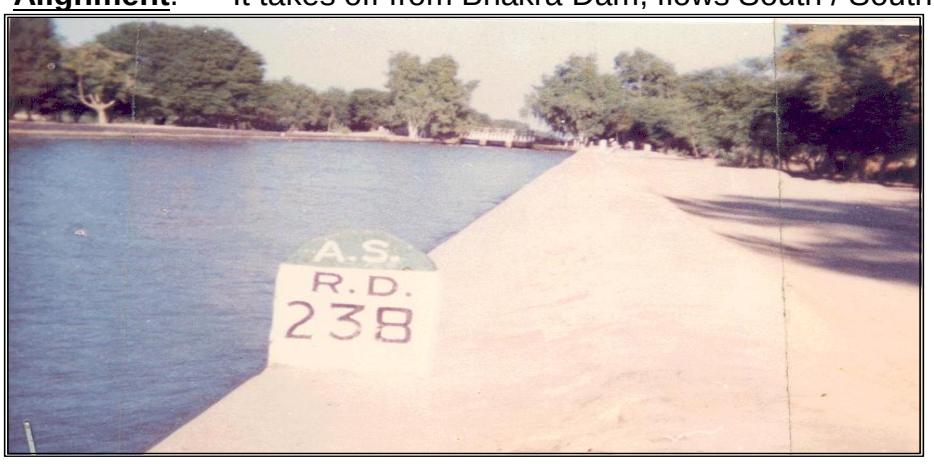
(8) **Service Roads**. Both banks have fair weather service roads.

(9) **Irrigation**. It will transform a vast waste stretch of desert in lower reaches of Punjab and Rajasthan into a fertile area. Its main branches are Suratgarh Branch, Anupgarh Branch and Bikaner Branch. The projects envisage resettlement of a vast population particularly from over populated areas.

d. **Bhakra Canal**. This Canal was constructed in 1950s. It irrigates area

Surrounding Karnal, Hissar and part of Rajasthan distributaries. Details are as under:

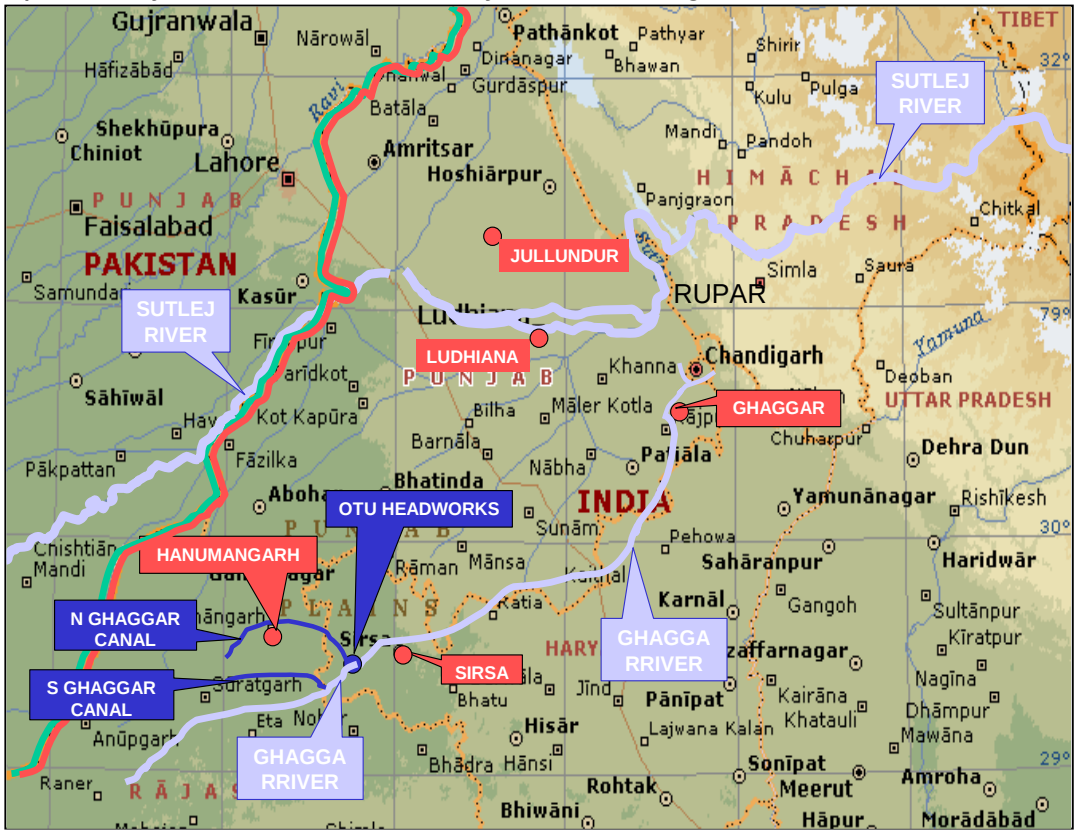
(1) **Alignment**. It takes off from Bhakra Dam, flows South / South



West and runs roughly parallel to River Sutlej up to Rupar and then runs parallel to Sirhind Canal for about 16 kilometres. It turns southward to Patiala and then to Pehowa (west of Thanesar). From Pehowa it flows westward to Thanesar and then to Dabwali (South East of Bhatinda) where it enters Ganganagar District.

(2) **Capacity**. Total capacity of this Canal is 12500 cusecs.

e. **Ghaggar Canal**. Two canals i.e. Northern and Southern Ghaggar Canals have been taken out from River Ghaggar at Otu Head Works. Both the Canals flow in western direction and are 6.4 to 9.6 kilometres apart. They terminate in the vicinity of Hanumangarh.



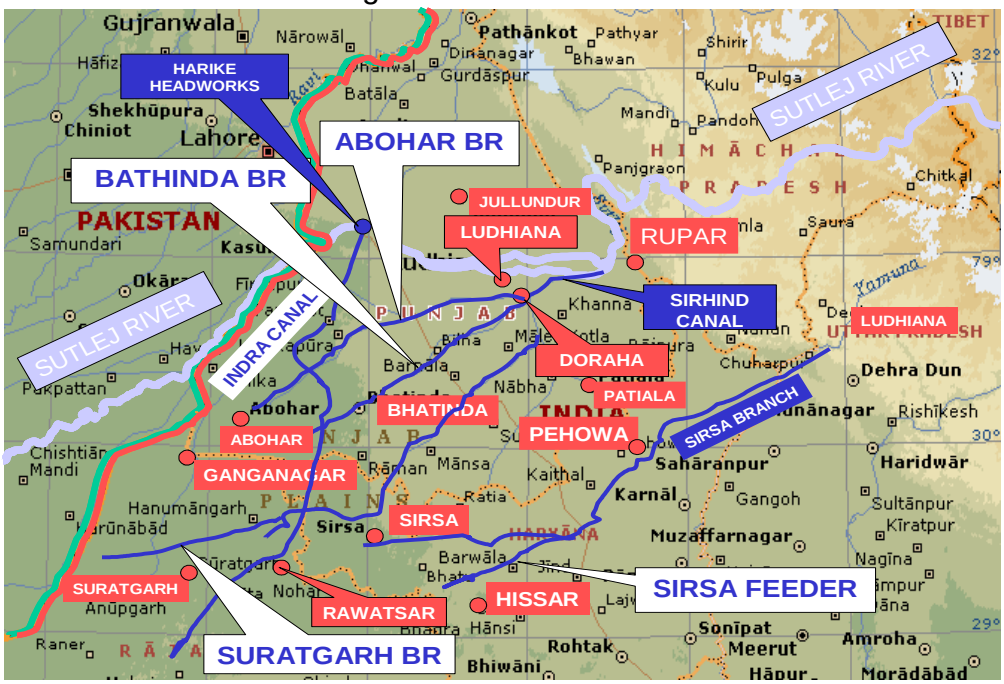
23. **Branches**. Details are as under: -

a. **Abohar**. It takes off from Rupar and tails off near Abohar. It is 10 metres wide and 2 metres deep and has a capacity of 3500 cusecs.

b. **Bhatinda**. It takes off from Sirhind Canal at Doraha and tails off near Bhatinda. It is 13.3 metres wide and 2.6 meters deep.

c. **Suratgarh**. It takes off from Indra Canal near Rawatsar.

d. **Sirsa Feeder**. It takes off from the Main Branch at Pehowa and flows south to supplement water of Sirsa Branch. It flows in North West to South West direction to irrigate area North East of Hissar.



e. **Tohana**. It takes off from the Main Branch at Tohana and flows in North East to South West direction. It irrigates Hissar District and part of Rajasthan.

f. **Rojhri**. It takes off from the Main Branch and flows in North East to South West direction. It irrigates North West part of Hissar District.

24. **Distributaries**. Annexure G & Q.

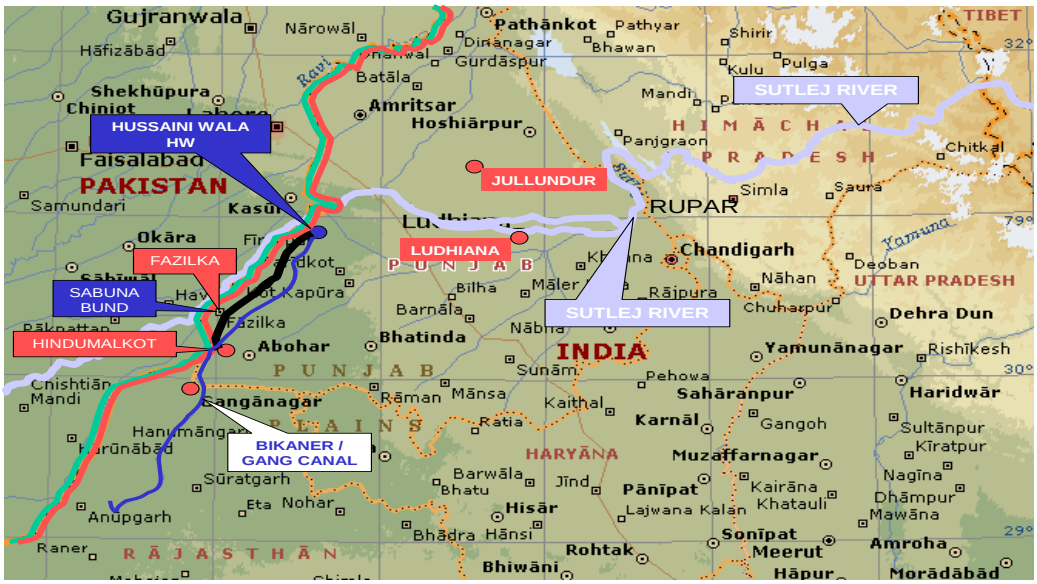
25. **Ditch Cum Bunds**. Sabuna is the only Ditch cum Bunds exists in this sector. Details are as under:-

a. **Subuna Drain**. Water is fed through Chand Bhan Drain and Gang Canal. Alignment is at Annexure Q. Tech data is as under:-

(1) Depth - 8 – 10 feet

(2) Water level - 7 feet

(3) Width - 70 feet



b. **Sabuna Bund**

(1) **Alignment**. As per Annexure Q.

(2) **Tech Data**

(a) Length - 20 Kilometres

(b) Top width - 3-5 metres

(c) Bottom width - 13-20 metres

(d) Height - 6-7 metre

(3) **Camouflage Arrangements**. Trees / shrubs have been planted on both sides of the bund.

(4) **Defence Works**. A number of bunkers and trenches have been constructed on the bund.

26. **Bunds**. Some important bunds are as under (Details at Annexure J & Q):-

Ser	Name	Length	Height
a.	Hindumalkot	3.2 kilometre	2.4 metres

b.	West of Binjor	18 kilometre	1.5 metres
c.	Nangi post	7 kilometre	3 metres
d.	Sabuna	22 kilometre	6-8 meters

e. **Other Bunds**

(1) Near Border Security Force Post Chak 23 - O

(2) Near Border Post number 300 / 2

(3) Near Binjor Post

(4) Near Border Post no 272 / 1

(5) Near Khakhian Border Security Force Post

(6) Near Border Post number 275 / M

27. **Cisfrontier**. Following are the main canals in this sector:-

a. **Lower Bari Doab Canal (LBDC)**. This Canal runs parallel to main Railway Line Lahore - Samasatta and National Highway Lahore - Multan. This is one of the major canals flowing from North East to South West. Width of this Canal varies from 67 to 80 metres with depth ranging from 3.25 to 4.25 metres. Class 9 F1 service track exists on Southern bank.

b. **Khanwah Branch**. It is originates from Dipalpur Canal. It is 17 metres wide and 1.6 metres deep. It flows South of Hujra and then bifurcates into two distributaries Nahrawala and Dipalpur Distributaries.

c. **Pakpattan Canal**. Originates from Sulaimanke Head Works with maximum discharge of 6,594 cusecs and flows towards West. A class 9F1 service track exists.

d. **Khadir Branch (RS 79)**. It originates from Pakpattan Canal (SQ 7292) and flows South West. The discharge at the Head is 2,230 cusecs. Its length is 77.12 Kilometres. A class 9 F1 service track exists.

e. **Balloki Sulaimanke (BS) Link I**. It is a Link Canal between Balloki Headworks and Sulaimanke Headworks. Primarily this Canal is designed to take on the over flow of water from Balloki Sulaimnake Link. It has common bank with Balloki Sulaimnake Link II. A service track runs along the three banks of the twin canals and is almost at equal height from the surrounding area. It is 50 to 67 metres wide and 4 to 4.25 metres deep.

f. **Balloki Sulaimanke (BS) Link II**. It is also link between Balloki and Sulaimanke Head Works. Primarily this Canal is designed to take on the over flow of water from Balloki Sulaimnake Link. It has common bank with Balloki Sulaimnake Link I. A service track runs along the three banks of the twin canals and is almost at equal height from the surrounding area. It is 50 to 67 metres wide and 4 to 4.25 metres deep.

g. **Fordwah Canal**. Originates from Sulaimanke Head Works and tails off near Bahawalnagar. It is seasonal irrigation canal. Road Sulaimanke - Bahawalnagar runs along this Canal, as such a separate service track is not required. It is 50 metres wide and 2.6 metres deep. Its discharge at the Head is 3,447 cusecs. Length of this Canal is 118.928 kilometres.

h. **Macleod Ganj Branch**. Originates from Fordwah Canal, flows in the direction North East to South West and tails off at square 9469. A class 9 F1 service track runs along the Western bank. It has a width of 11.3 to 14 metres and depth varies from 1.3 to 1.4 metres. The discharge of the Canal is 374 cusecs.

j. **Eastern Sadiqia Canal (ESC)**. It originates from Sulaimanke Head Works and flows North West to South West. This Canal runs along Fordwah Canal for a distance of 8.60 kilometres upto Bareka (0687). From there it turns South West. A class 9 F1 service track exists on the eastern bank upto RD 80. For the remaining length, the track runs along west bank. The discharge at the Head is 6,080 cusecs. Length of the Canal is 78.4 kilometres.

k. **Hakra Main Branch**. It off shoots from the tail end (Eastern Sadiqia Canal (ESC). It has a discharge of 2,708 cusecs at the Head and runs parallel to the Border. Its width varies from 16 to 37 metres and depth from 1.5 to 2.4 metres. Its length is 92.49 kilometres.

l. **Bahawal Canal**. It originates from Islam Head Works and flows towards South, parallel to Road Hasilpur - Bahawalpur. Mailsi Sulaimnake Link Canal joins it at RD 140. Before confluence it is called as Upper Bahawal Canal. It has a discharge of 5,400 cusecs at the Head. Length of the Canal is 76.80 kilometres, with width varying from 46 to 50 metres and depth is 4 metres.

m. **Desert Branch (RW 28)**. It originates from the tail end of Bahawal Canal and flows towards South / South East. At the Head, the discharge is 2,516 cusecs. Length of this Branch is 64.80 kilometres. It width varies from 25 to 37 metres, and depth 1.9 to 2.5 metres.

Fencing

28. **Pattern and Layout of Fencing**. Indians have constructed four types of fence i.e type Alpha, Bravo, Charlie and Delta along the Indo - Pakistan Border near Zero Line. This fence has been erected about 100 to 3000 metres from the Zero Line / International Border. Patrols are employed at night; whereas link patrolings and Border Security Force Troops are employed during the day for surveillance. New towers having height of 9 to 10 metres (30 to 35 feet) have been constructed along the fence at two to three Kilometres interval for continuous observation during day. Search lights have been installed for night surveillance sketches showing plain / side view and oblique view are at Annexure Q. Details are as under:-

a. **Type Alpha**. An un-climbable double security fence, which is the most formidable of the four types. Its design features are as under: -

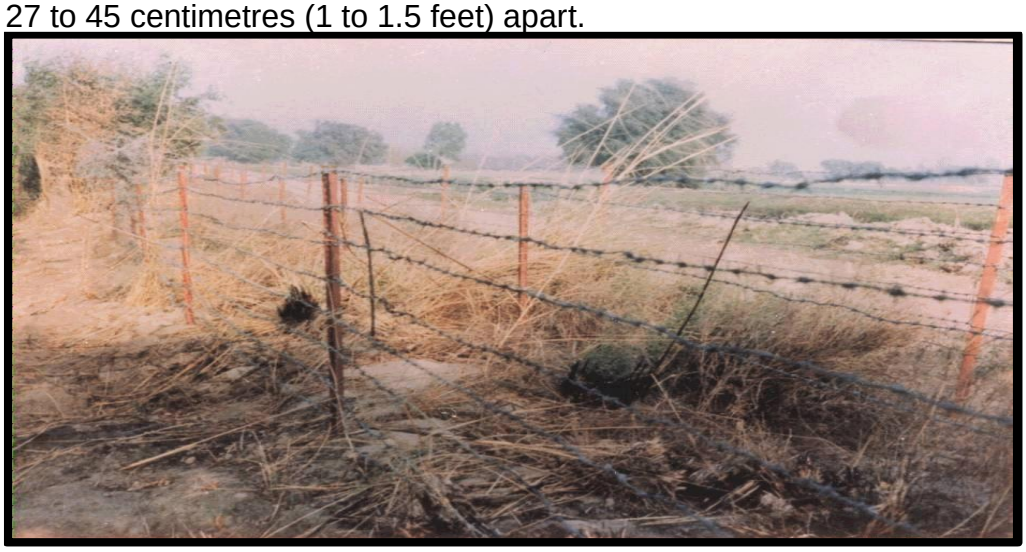
(1) To provide continuous observation, towers having height between 9 - 10 metres (30 - 35 feet) have been constructed along the fence at an interval of approx two to three kilometres.

(2) The fence has been erected about 100 to 3000 metres from the Zero Line. The project appears to be well planned and executed.

b. **Type Bravo**. This is a double concertina coil / wire fence with iron pickets.

c. **Type Charlie**. This is a three layered concertina wire fence.

d. **Type Delta**. This is a simple barbed wire fence with four to six strands 27 to 45 centimetres (1 to 1.5 feet) apart.



29. **Surveillance System**. Besides fencing an elaborate surveillance plan has been developed through construction of Observation Post (OP) towers for better observation into Pakistan. These towers are of varying height and are located in varying depth along the border. These are sufficient in number to have effective surveillance over their area of interest. To have effective observation during night a comprehensive lighting arrangement has been executed.

a. **Layout and Configuration of OP Towers**. Indians have established a very comprehensive observation system based on OP towers close to the Zero Line in order to enhance its effectiveness. These towers have height varying from 3 to 30 metres. The height of towers with scant

afforestation on Pakistan side of Border renders the observation system completely ineffective. The OP towers are manned round the clock and night vision devices (NVDs) are used during dark hours.

b. **Illumination**. Search lights are installed at various locations, which

have control system at the OP towers to illuminate area of interest.

c. **Energization of Fence**. Reportedly, Indians are trying to energise the fence at selected places. However, energization of complete fence is

not possible owing to massive voltage conductor wires, difficulties of earthing and elaborate arrangements required for transmitting the large quantity of electric power.

d. **Power Source**. The electricity is being supplied through diesel generators which have been installed at Border Security Force Company Headquarters posts. The running expenditure of these generators is quite expensive.

30. **Progress of Fence**. Complete frontage less the riverine area along south of Sutlej have been fenced. Out of total frontage of 410 kilometres, 380 kilometres have been fenced. Sketch showing alignment of fence is given at Annexure Q.

31. **Miscellaneous**

a. **Steel OP Towers**. Refer Annexure J.

b. **Micro Wave Towers**. Refer Annexure J.

c. **Radars**. Radars are located at following places (Refer Annexure H): -

(1) Rai Singnagar.

(2) Suratgarh.

(3) Village Dhelu.

d. **Pill Boxes / Bunkers**. Refer Annexure J & Q.

e. **Border Out Posts (BOPs)**. Refer Annexure J.

f. **Strong Points**. The strong points in this sector are as under (Refer Annexure Q): -

(1) **Ganganagar**. The defence of Ganganagar is based on Gang Canal. Therefore, bridges near Mirzawala 9748, Chak 9Y 0352 and at 0858 have two bunkers each. There are four bunkers on road leading to Ganganagar town for inner defence.

(2) Details of other strong points in the area are as under: -

Serial	Name	Number of Bunkers / Pill Boxes
(a)	Hindumalkot	12
(b)	Kesri Singhpura	6
(c)	Sri Karanpur	11
(d)	Gaj Singhpura	4
(e)	Raisinghnagar	6
(f)	Anupgarh	4
(g)	Binjor	4
(h)	Jandwala	Each bunker has three man holes

g. **Dams**. Refer Annexure K.

h. **Headworks / Regulators**. Refer Annexure K and Q.

j. **Firing Ranges**. Refer Annexure L.

k. **Ground Relief**. Sketch showing relief of ground is at Annexure P.

l. **Wind Direction**. During winters, wind blows from West to East. During spring, North West and South West wind also joins the easterly blowing wind. During summers, low pressure starts developing which results into blowing of wind in western direction. This phenomenon continues till end of autumn. Sketches showing direction of wind in different months of the year are given at Annexure U to UU.

SECTION – 5

LOGISTICS PROBLEMS IN RAJASTHAN

32. **General**. The nature of terrain in Rajasthan is extremely difficult and hostile. However, India has launched a massive plan of uplifting the area by carrying out improvements in water supply system and construction of new roads and railway lines. With the development in communication infrastructure and exploration of water resources, the area has assumed new operational significance; Rajasthan is now regarded as the most important sector for major operations in the area. Logistic problems, through multifarious arrangements are being gradually overcomed by India. Logistic problems, which might be faced in the area are discussed in ensuing paras.

33. **Water Supply**. Acute scarcity of water is one of the major problems of Rajasthan. The conditions are worse in the western part of Rajasthan adjacent to Pakistan. Indra Canal is main contributing factor to ease the water supply problem. Other sources like deep tube wells can meet the local requirement to some extent. Details of water supply system are discussed in the succeeding paragraphs:-

a. **Sources of Water Supply**. Sources of water in Rajasthan are: -

(1) **Rainfall**. Rainfall in the western region is scanty and some time there is no rain at all for several years. Where possible rainwater is collected in small ponds and used by local population. The state of annual rainfall is as under: -

(a) Bikaner District - 20 to 25 centimetres

(b) Rest of the desert - Maximum of 10 centimetres

(2) **Canal Water**. Indra Canal is one of the largest irrigation projects of the world. The canal will ultimately fall into the Gulf of Kutch. The canal has capacity of 18,500 cusecs at the head regulator. Water from this canal has transformed the complete configuration of this arid land.

(3) **Under Ground Water**. Ground water in most of the Rajasthan is brackish. Wells at the depth of 60 to 90 metres yield brackish water. For potable water, wells up to the depth of over 180 metres have to be dug. Good quality water can be made available by deep bores.

b. **Water Distribution System**

(1) **Water Tanks**. Water tanks have been constructed all over the area for storage of rain and ground water, there are more than 600 water tanks in complete area. Most of them are situated in populated areas away from the border.

(2) **Pipelines**. Pipelines have been laid from the main water sources to the required areas. According to the Indian Government policy, villages with the population of over 2500 would get pipeline water and those with less population will have wells and water tanks.

(3) **Carriage of Water**. Water trailers are in regular use for carriage of water to the forwarded areas. In summers, when yield of wells reduces considerably, water is brought to the main towns by trains. During exercises, the provision of water to the troops is mainly by water trailers.

(4) **New Project**. Rajasthan is considered as one of the important strategic objectives by India. Accordingly, great emphasis has been laid on improving the logistic infrastructure in the area. Lot of money has been spent on development of water resources. Construction of Indra Canal at the cost of Rupees 1900 Million will solve water supply problems in the area. The work on Indra Canal has now been accelerated since enough water is available from Bhakkra reservoir for the construction work.

34. **Maintenance of Communication Infrastructure**

a. **Railways**. Rajasthan is not very well served with railway as compared to the bordering State of Punjab. The area was neglected and there was no agricultural activity. The construction of railway in this part was not considered a public necessity. However, the Indian government is now making efforts for reclaiming the area by exploring the under ground water resources and bringing water through Indra Canal from Harike Headworks. Strategic reasons have compelled the Indian Government to undertake an expansion of existing railway network in the area and lot of improvements have taken place.

b. **Roads**. Border Road Development Board of India has constructed a number of strategic roads along Pakistan Border in Western Rajasthan. The terrain condition across Punjab is getting worse from military point of view, this is because of presence of water logging and obstacles. Therefore, India has now started giving more importance to Rajasthan Sector. Indian Army Engineers are also being trained to lay duckboard tracks in desert.

c. **Importance of Metalled Roads in the Area**. Unmetalled roads in the area cannot sustain traffic. Roads are not easy to construct / maintain due to sand storms and shifting of sand dunes. India is now focusing on construction of metalled roads in this area. There are number of penetrates and laterals, which facilitate rapid movement of forces thus providing operational flexibility to the force operating in this sector.

d. **Maintenance of Metalled Roads**. The metalled roads often are buried under sand, thus posing a major maintenance problem. During operations, India will have to organize maintenance teams at large scale to ensure smooth traffic in this sector.