PROPOSAL FOR RECONNAISSANCE SURVEY (G4) FOR POTASH IN CHOHARIANWALI BLOCK (48.00 SQ.KM AREA), PUNJAB EVAPORITE BASIN, DISTRICT- FAZILKA, PUNJAB.

COMMODITY: POTASH

BY

MINERAL EXPLORATION AND CONSULTANCY LIMITED

DR. BABASAHAB AMBEDKAR BHAWAN

SEMINARY HILLS

PLACE: NAGPUR

DATE: 19th & 22nd JANUARY, 2026

SUMMARY OF THE BLOCK FOR RECONNAISSANCE SURVEY (G4)
GENERAL INFORMATION ABOUT THE BLOCK

	Features	**Details**
	Block ID	Choharianwali Block
	Exploration Agency	Mineral Exploration and Consultancy Limited
	Commodity	Potash
	Mineral Belt	Punjab Evaporite Basin, northern fringe of Nagaur-Ganganagar Basin (Northwestern Part of Rajasthan).
	Budget & Completion period with entire Time schedule to complete the project	1877.24 lakhs & 21 Months
	Objectives	i) To confirm the continuity and potentiality of potash bearing zones in the proposed area. ii) To generate data for assessment of mineralogy of the potash zones and the K contents. iii) To evaluate the resource potentiality of potash and halite mineralization as per UNFC system in 334 Category.
	Whether the work will be carried out by the proposed agency or through outsourcing and details thereof. Components to be outsourced and name of the outsource agency	Work will be carried out by the proposed agency.
	Name/Number of Geoscientists	Two no Geoscientist (1 Field + 1 HQ)
	Expected Field days (Geology, Geophysics, Surveyor)	Geologist Party days on Field: 540 days
		Geologist Party days on HQ: 90 days

<table>
<tr><td>1.</td><td>Location</td><td></td></tr>
<tr><td></td><td>Latitude-Longitude</td><td>The proposed block, i.e., Choharianwali Block falls in the Survey of India Toposheet No. 44J/03, east of Fazilka district in the Punjab Evaporite Basin.
<table>
<tr><th rowspan="3">CARDINAL POINTS</th><th colspan="2">ZONE-43(NORTH)</th><th colspan="2">WGS-84</th></tr>
<tr><th colspan="2">UTM (m)</th><th colspan="2">DMS</th></tr>
<tr><th>NORTHING</th><th>EASTING</th><th>LONGITUDE</th><th>LATITUDE</th></tr>
<tr><td>A</td><td>3367438.51</td><td>410576.14</td><td>74°04'07.50"E</td><td>30° 26'08.66"N</td></tr>
<tr><td>B</td><td>3367005.80</td><td>415757.36</td><td>74°07'21.85"E</td><td>30° 25'55.95"N</td></tr>
<tr><td>C</td><td>3357862.27</td><td>414994.74</td><td>74°06'55.94"E</td><td>30° 20'58.75"N</td></tr>
<tr><td>D</td><td>3358291.83</td><td>409813.14</td><td>74°03'41.74"E</td><td>30° 21'11.35"N</td></tr>
</table></td></tr>
<tr><td></td><td>Villages</td><td>Choharianwali, Kauranwali, Jiwanpur, Kikarwala Rupa,etc.</td></tr>
<tr><td></td><td>Tehsil/Taluk</td><td>-</td></tr>
<tr><td></td><td>District</td><td>Fazilka</td></tr>
<tr><td></td><td>State</td><td>Punjab</td></tr>
<tr><td>2.</td><td>Area (hectares/ square kilometres)</td><td></td></tr>
<tr><td></td><td>Block Area</td><td>48.00 Sq. Km</td></tr>
<tr><td></td><td>Forest Area</td><td>Data Not Available</td></tr>
<tr><td></td><td>Government Land Area (Bilanam)</td><td>Data Not Available</td></tr>
<tr><td></td><td>Charagaha</td><td>Data Not Available</td></tr>
<tr><td></td><td>Private Land Area</td><td>Data Not Available</td></tr>
<tr><td>3.</td><td>Accessibility</td><td></td></tr>
<tr><td></td><td>Nearest Rail Head</td><td>Fazilka</td></tr>
<tr><td></td><td>Road</td><td>NH-10</td></tr>
<tr><td></td><td>Airport</td><td>Bhatinda</td></tr>
<tr><td>4.</td><td>Hydrography</td><td></td></tr>
<tr><td></td><td>Local Surface Drainage Pattern (Channels)</td><td>Shifting courses of the Sutlej and the seasonal Ghaggar rivers.</td></tr>
<tr><td></td><td>Rivers/ Streams</td><td>Irrigation canals, notably branches of the Sirhind Canal and Rajasthan Canal.</td></tr>
<tr><td>5.</td><td>Climate</td><td></td></tr>
<tr><td></td><td>Mean Annual Rainfall</td><td>The annual rainfall, averaging 300–450 mm.</td></tr>
<tr><td></td><td>Temperatures (December) (Minimum) Temperatures (June)</td><td>Summers, April to June, are intensely hot, with maximum temperatures frequently reaching 44–47 °C, while winters (December–January) are cold to cool, with minimum temperatures dropping to 2–5 °C and daytime highs around 15–20 °C.</td></tr>
</table>

	(Maximum)	
6.	**Topography**	
	Toposheet Number	44J/03
	Morphology of the Area	Covered by Aeolian Sand.
7.	**Availability of baseline geoscience data**	
	Geological Map (1:50K/25K)	1:50,000
	Geochemical Map	Sand cover Area
	Geophysical Map (Aeromagnetic, ground geophysical, Regional as well as local scale GP maps)	NGPM, Gravity and Magnetic data available.
8.	**Justification for taking up Reconnaissance Survey/ Regional Exploration**	With the amended MMDR rules, the Central Government has begun auctioning critical mineral blocks. Potash-bearing blocks in Nagaur-Ganganagar Basin (Rajasthan) — Jaitpur, Lakhasar, Bharusari, Satipura — are already on the auction platform.The Amalgamated Shergarh-Sherawala-Ramsara-Dalmirkhera Block (southern side of the proposed block) in Fazilka District, Punjab (Punjab Evaporite Basin, PEB) is included in the VIth tranche of auctions by the Ministry of Mines. Punjab Evaporite Basin (PEB): Located in southwestern Punjab is partially explored. The Basin composed of older alluvium and aeolian sediments (Middle Pleistocene–Holocene). Seven halite cycles (H1–H7) identified in boreholes drilled by GSI in the amalgamated block. Resource Estimates (Amalgamated-Shergarh-Sherawala-Ramsara-Dalmirkhera Block) (Figure:1) Area: 45.93 sq km (4592 ha), based on 6 boreholes drilled between FS 2019–21 and FS 2022–24. Potash (K_2O):281.45 MT @ 3.72% (2% cut-off) 34.34 MT @ 7.42% (5% cut-off) 12.96 MT @ 9.56% (8% cut-off) Halite: 2442.17 MT @ 35.18% natural cut-off. Block bounded by coordinates: A: 30.054544 N, 74.032906 E, B: 30.055348 N, 74.085264 E, C: 29.972995 N, 74.086429 E, D: 29.973284 N, 74.033732 E. To confirm sub-surface lithology and lateral continuity of potash-bearing halite cycles, further drilling is required in the Punjab Evaporite Basin (PEB) (northern fringe of Nagaur Ganganagar Evaporite Basin). The proposed Choharianwali Block (northern side of amalgamated block, within PEB) should be explored on a 1600m × 1600m grid. The G4 exploration will establish potentiality, making the block auctionable, further developing into potash mines to meet rising fertilizer demand.

PROPOSAL FOR RECONNAISSANCE SURVEY (G4) FOR POTASH IN CHOHARIANWALI BLOCK (48.00 SQ.KM AREA), PUNJAB EVAPORITE BASIN, DISTRICT- FAZILKA, PUNJAB.

1.0.0 Preamble

1.1.0 Background

1.1.1 Potassium, Nitrogen and Phosphorous (K, N & P) are the key chemical contents used in the Fertilizer Industry. Major production of potash in the world is obtained from Sylvite (KCl) and Polyhalite [$K_2Ca_2Mg\ (SO_4)_4 \cdot 2H_2O$] associated with Halite (NaCl) bearing evaporite sequences. India produces only meager quantity of potash as by-products during the manufacture of common salt from seawater and the entire requirement of potash is met through imports. The only known occurrence of potash of some possible economic relevance happens to be the potash bearing evaporite sequence of NW Rajasthan also known as Nagaur-Ganganagar evaporite basin (N-G basin). Discovery of potash deposits in the Nagaur-Ganganagar basin of Rajasthan is looked forward to ease the country's situation. This basin was historically explored by GSI over a long gestation period spanning from 1974 to 1991. The above work of GSI could establish the potash exploration potential of the basin.

1.1.2 In the backdrop of country's continued dependence on import of a very large quantity of potash nutrients with heavy outgo of foreign exchange, the subject was given due consideration at the level of Ministry of Mines, Government of India and the decision was taken to revisit the potash bearing evaporite prospect of Rajasthan and to further work out the exploitation feasibility of the Nagaur-Ganganagar basin so that the prospect can be developed as an auctionable property. In the meeting held on 15th December 2009, under the Chairmanship of Secretary (Fertilizers) possibility of exploration and augmenting indigenous production of rock phosphate and mining for availability of rock phosphate for the indigenous fertilizer industry was discussed. Apart from this the matter related to exploration of Potash and Fertilizer minerals (Phosphorite, Apatite etc) was also discussed in details and decided that exploration of fertilizer mineral deposits in the country should be taken on priority to save a huge foreign exchange for meeting the domestic demand. The matter of Potash exploration of Rajasthan was also discussed in the 1st meeting of National Mineral Exploration Trust (NMET) held on 8th October-2015.

1.1.3 It was suggested that Department of Mining & Geology (DMG), Government of Rajasthan, Mineral Exploration Corporation Ltd. (MECL) and Geological Survey of India (GSI) under Ministry of Mines could take up the further exploration work for potash in Nagaur-Ganganagar basin.

1.1.4 The Nagaur–Ganganagar Evaporite Basin (NGEB) of Rajasthan extends into southern Punjab, covering parts of Fazilka, Sri Muktsar Sahib, and Mansa districts (erstwhile Bhatinda and Faridkot), as well as Sirsa district of Haryana. The basin trends NNE–SSW with a regional dip of 2º-3º, though local structural deformations occasionally steepen the dip to about 28º. Stratigraphically, the area hosts formations ranging from the Neoproterozoic to Quaternary, with relatively limited tectonic disturbance.

1.1.5 Within this basin, the Hanseran Evaporite Group (HEG) is the principal potash-bearing unit, comprising cyclic deposits of halite interbedded with potash minerals (polyhalite, sylvite, sylvinite, langbeinite, and carnallite). These are intercalated with anhydrite, clay, dolomite, magnesite, and occasionally glauberite.

1.1.6 Exploration by the GSI between 1974 and 1991 delineated eight sub-basins in Rajasthan with potash mineralization above 2% K namely Lakhasar, Bikaner, Gharsisar, Hanseran, Arjunsar, Jaitpur, Bharusari, and Satipura. In Punjab and Haryana, early work by Dey and Saxena (1981-84) identified evaporitic horizons in Faridkot, Ferozepur (now Fazilka, Sri Muktsar Sahib, and Mansa), and Sirsa districts, supported by boreholes HP-1 and HP-2. HP-1 in Sirsa intersected anhydrite horizons between 411-461 m, while HP-2 in Punjab encountered five evaporite cycles, including two halite-bearing zones with a cumulative thickness of ~48 m.

1.1.7 Subsequent exploration included borehole HP-3 at Sadhuwali, Sri Ganganagar (1985-86), which was abandoned at 634 m, and more recently, investigations by Digvijay (2018–19) in Qabrwala Block (Sri Muktsar Sahib), which indicated resources of ~6 million tonnes grading 3.9% K at 3.5% cut-off. Further drilling during 2019-21 in the Sherewala-Shergarh-Ramsra Block intersected multiple potash horizons, with cumulative thickness up to 115 m and reconnaissance resources of ~409 million tonnes at 2% K cut-off. In 2022-23, five scout boreholes drilled in Shergarh-Dalmirkhera Block added ~202 million tonnes of resources at 2% K cut-off.

1.1.8 The MECL has carried out NGPM work in toposheet nos 44J/3, 4,6 and 7 in parts of Fazilka, Muktsar, and Firozpur Districts in Punjab during first and second quarter of

FS 2025-26. The gravity anomaly contour map has been superimposed on the magnetic anomaly map, providing an integrated view for identifying potential zones for further geophysical investigation. Low to moderate gravity anomaly surrounded by high gravity may suggest a localized basement depression or sub-basinal structure. This structural configuration is geologically significant; as such depressions in study area are often associated with the accumulation of Evaporitic Sequences, including anhydrite, halite, and potash salts, which exhibit lower densities relative to the surrounding high-density rocks. This interpretation is further strengthened by its proximity to recently explored potash-bearing blocks, such as Shergarh -Dalmirkhera and Sherewala in the Fazilka district.

1.1.9 Based on the outcome of the work submitted by MECL, three blocks have been proposed for exploration. Out of three blocks, 02 blocks are potential for potash exploration i.e. Blocks A1B1C1D1 and A2B2C2D2. The three demarcated blocks are shown in figure no. 2 The potash exploration by GSI is already under progress in the toposheet no 44J/04 & 44J/08. The block A1B1C1D1 overlaps with the proposed FSP of GSI.

1.1.10 The block A2B2C2D2 proposed for potash exploration by MECL falls in the toposheet no. 44J/03. The A2B2C2D2 block exhibits a low magnetic anomaly along with a relatively low Bouguer anomaly compared to the surrounding areas. This geophysical configuration is indicative of subsurface conditions conducive to the accumulation of Evaporites, suggesting that this block may also be a promising target for Potash Exploration.

1.2.0 Location and Accessibility

1.2.1 The Potash and Halite bearing Choharianwali Block lies in the Punjab Evaporite Basin (PEB) which is the northern extension of Nagaur-Ganganagar Evaporite Basin of Rajasthan. The proposed block falls in the Survey of India Toposheet No. 44 J/03 covered by N Latitude 30°21'11.35" to 30°26'08.66" and E Longitude 74°03'41.74" to 74°07'21.85". The blocks lie on the eastern side of the District Fazilka.

1.2.2 The Fazilka town is located in the southwestern part of Punjab near the India–Pakistan border, are well connected through a combined network of railways, national highways, and state roads, ensuring ease of accessibility despite their semi-arid setting. The area is primarily served by the Bathinda–Fazilka–Firozpur railway line,

with junction at Fazilka. Road connectivity is anchored by National Highway 7 (NH-7), which traverses Abohar and Fazilka, providing direct links to Bathinda and Delhi to the east and extending towards the Hussainiwala border near Firozpur in the west, while NH-354 connects Fazilka and Firozpur to Amritsar. Additionally, a network of state highways, including SH-13, SH-20, and SH-32, integrates Muktsar Sahib, Jalalabad, and surrounding agricultural belts with the NH corridors. Supplemented by the Rajasthan Canal Road system, which serves rural and canal-colony settlements around Abohar and Jalalabad.

Fazilka is around 8 km from the study area (Plate No-I). Choharianwali Block with 48.00 sq.km area is located in the Punjab Evaporite basin and coordinates of the cardinal points of Choharianwali block boundary are given in Table-1

Table-1
Co-ordinates of the cardinal points of Block Boundary of the Choharianwali Block, Punjab Evaporite Basin, Dist: Fazilka, Rajasthan.

CARDINAL POINTS	ZONE-43(NORTH)		WGS-84	
	UTM (m)		DMS	
	NORTHING	EASTING	LONGITUDE	LATITUDE
A	3367438.51	410576.14	74°04'07.50"E	30° 26'08.66"N
B	3367005.80	415757.36	74°07'21.85"E	30° 25'55.95"N
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D	3358291.83	409813.14	74°03'41.74"E	30° 21'11.35"N

1.3.0 Physiography, Climate & Vegetation

1.3.1 The study area occupies a stretch of the southwestern Punjab plains, close to the Indo-Pakistan border, and forms part of the semi-arid tract of the Sutlej–Ghaggar interfluve. Physiographically, the area is dominated by flat to gently undulating alluvial plains, composed of Quaternary deposits laid down by the shifting courses of the Sutlej and the seasonal Ghaggar rivers. The soils vary from sandy loam to loam, with patches of clay in depressions, and are generally fertile but prone to salinity in poorly drained zones. Scattered throughout the western and central portions are stabilized and semi-stabilized sand dunes (tibbas), remnants of older aeolian activity, oriented northwest–southeast, which locally interrupt the otherwise level terrain. The landscape is interlaced with irrigation canals, notably branches of the Sirhind Canal and Rajasthan Canal, which sustain agriculture in this otherwise arid zone.

1.3.2 Climatically, this belt experiences a semi-arid to arid climate with pronounced extremes. Summers, lasting from April to June, are intensely hot, with maximum temperatures frequently reaching 44–47 °C and occasionally exceeding 48 °C during heatwaves, while winters (December–January) are cold to cool, with minimum temperatures dropping to 2–5 °C and daytime highs around 15–20 °C. The annual rainfall, averaging 300–450 mm, is concentrated during the southwest monsoon (July–September), though highly variable, leading to both droughts and localized flooding in areas. For most of the year, humidity remains low, often under 20% in peak summer, and strong dust-laden winds (loo) prevail in May–June, intensifying evapotranspiration and soil erosion. Despite natural aridity, canal irrigation has enabled intensive farming, though salinity, dune reactivation, and waterlogging pose persistent challenges.

1.5.0 Previous work

1.5.1 The evaporite minerals like gypsum, anhydrite and halite were known from Nagaur and Bikaner districts since 1930's. Particular mention may be made of the reported occurrence of halite in Bikaner (P.K.Ghosh, 1952), gypsum in Nagaur (Roy Chowdhury et al., 1965) and the intersection of anhydrite in the boreholes drilled by Central Groundwater Board (CGWB) and Oil and Natural Gas Commission (ONGC). George I. Smith (1968) of USGS evaluated the data collected by GSI and identified that Nagaur-Ganganagar Basin is one of the areas, geologically most favorable for occurrence of potash-bearing marine evaporate deposit. Jones (1970) studied the halite deposits of the Salt Range, Pakistan, suggested the Nagaur Basin to be a prospective halite bearing area, Sinha et al. (1973) of CGWB, while exploring for ground water, reported halite from Lakhasar at a depth of 541m and correlated it with Kohat Salt sequence of Pakistan. Presence of halite at a depth of 469 m was further reported by CGWB from Satipura in Sri Ganganagar district, Rajasthan.

1.5.2 Dey, R.C. and Saxena, S.M (FS: 1981-84) carried out integrated search for potash bearing evaporites in parts of Bhatinda, Faridkot and Ferozepur districts of Punjab and Sirsa district of Haryana. Total three boreholes were drilled. Two boreholes (HP-1 and HP-2) were drilled in FS: 1981-82, 1982-83 and 1984. The two boreholes (HP-1 and HP-2) were spaced 52 km apart and covered two districts (Sirsa district of Haryana and erst while Faridkot district of Punjab). The first borehole HP-1 was

located at Maujgarh (Sirsa district, Haryana) to test the Bouguer low gravity anomaly (of the order of –36 m.gal). Below the Quaternary overburden of 305m, low order evaporites (anhydrite, gypsum dolomite, limestone with intervening marls) were encountered at depth of 411.55 - 461.55 m. Two anhydrite zones were encountered around 434m (0.65m thick anhydrite) and 445.75-448.25m (2.50 m thick anhydrite). The borehole was closed at a depth of 528.60 m within the Jodhpur sandstones, which form the floor of the evaporite basin. The second borehole (HP-2) was located near Qabrwala (erst while Faridkot district of Punjab now re-organized to Sri Muktsar Sahib District, Punjab). On geological considerations although geophysical surveys (gravity and subsequent seismic refraction) had indicated/deciphered a north south trending major fault at the location of HP-2, moreover the IV layer character of the sub stratum was not picked up in seismic refraction soundings. This borehole subsequently encountered five cycles of evaporites with the bottom two cycles containing halite. Total 130.77m of evaporites (halite with polyhalite, anhydrite gypsum, dolomite and limestone with associated marl) were encountered at depth from 475.05 m to 605.82 m. Halite constitutes a thickness of 47.78 m. The two-halite cycles are separated by 2.82m thick zones of clay and anhydrite. The entire area is covered with a thick blanket of alluvial and aeolian deposits. Primary stratifications are sub-horizontal (20 to 30) in nature and dipping towards west. The chemical analysis of old borehole (HP-2) is not appended in the circulated report (Dey, R.C. and Saxena, S.M., FS: 1981-82, 1982-83 and 1984).

1.5.3 Sharma, R.K., (FS: 1985-86, Fig.4.1) carried out integrated search for potash bearing evaporites in parts of Ferozpur district, Punjab. The borehole (HP-3A) was located at Sadhuwala in Sri Ganganagar district about 1.2 km. in Rajasthan. The borehole was projected to be drilled upto about 1000m to intersect the various evaporite zones but could be drilled only up to 634.25m only due to drilling problems.

1.5.4 Raj Digvijay, (FS: 2018-19) drilled one borehole (PMQB-01) in Qabrwala block falling in part of Sri Muktsar Sahib district of Punjab in which 5.98 million tonnes potash K+ with an average grade of 3.90 K+% at 3.5% cut off with thickness of 14.7m recorded. The borehole was abandoned as it could not reach the approved depth and geophysical logging was not carried out.

1.5.5 **Details of Geophysical Survey**: Geophysical mapping was conducted on toposheet numbers 44K/01, 02, 03, 05, and 06, covering parts of Sri Ganganagar, Hanumangarh, Fazilka, Mukatsar, and Sirsa districts across Rajasthan, Punjab, and Haryana by Shailendra Kumar Bharati, Sunny Kumar Ranjan, and Deepak Maurya during 2021–22. The study identified two prominent, parallel high-anomaly zones over silt, clay, and kankar deposits. Variations in the gravity anomalies were primarily attributed to changes in basement depth.

1.5.5.1 Earlier, Chatterjee et al. (1984) carried out gravity, magnetic, and seismic surveys in parts of Sirsa District (Haryana), Bhatinda, Faridkot, and Firozpur districts (Punjab), and Sri Ganganagar District (Rajasthan). Their results delineated zones with steep gravity gradients along an ENE–WSW-trending chain of combined gravity–magnetic highs, suggesting the presence of a possible deep-seated intrusive fault zone.

1.5.5.2 MECL conducted priority gravity and magnetic surveys across four toposheets—44J/03, 44J/04, 44J/06, and 44J/07—focused on potash exploration in Punjab. These sheets collectively cover portions of Fazilka, Muktsar, and Firozpur districts, with 44J/03 and 44J/04 entirely in Fazilka, 44J/07 spanning Muktsar and Fazilka, and 44J/06 extending across Fazilka, Muktsar, and Firozpur, along with a small part of western Faridkot district. The total area is 2,680 km², of which 2,647 km² was successfully surveyed to produce baseline GM data. Based on variation of Bouguer and Magnetic anomalies and their derivatives incorporated with NGLM lineaments and Geological studies. Three blocks have been identified as potential zones and recommended for further scientific research.

2.0.0 Regional Geology

2.1.1 The Nagaur-Ganganagar Evaporite Basin is intra-cratonic basin in which marine sediments of Marwar Supergroup were deposited on the basement rocks of Malani Igneous Suite and/or Delhi metamorphites. This basin is considered the southernmost continuation of this large Eocambrian basin of which Salt Range of Pakistan forms the northern part (Geol. Surv. Ind., Special Pub. No.62). According to Virendra Kumar et al (2005) Nagaur-Ganganagar Basin, covers over 1,00,000 sq km and in parts of Ganganagar, Hanumangarh, Churu, Bikaner, Nagaur, Jodhpur, Jaisalmer and

Pali Districts of Rajasthan, Sirsa District of Haryana and erst while Faridkot and Bhatinda Districts of Punjab.

2.1.2 Geologically, the study area is a part of Indo-Gangetic alluvial plain. The area is covered by thick pile of fluvial sediments which are classified as Older Alluvium. It is extensively developed and is composed of multicyclic sequence of brown to grey silt, clay with kankar and reddish brown to grey micaceous sand.

Subsurface geology from drilled borehole, near Qabrwala village, Sri Muktsar Sahib District of Punjab (Source: GSI)

Age	Formations	Lithology
Quaternary		Blown sand, sand & kankar sand with gravel & clay.
Tertiary	Marh Formation	Reddish to yellowish sandstone.
	Palana Formation	Clay and carbonaceous shale Lignite. Yellowish, medium-grained sandstone with clay
Palaeozoic	NagaurGroup	Reddish-colour fine to coarse gritty sandstone. Sandstone & siltstone with clay.
Eocambrian	Evaporite Group	Red, maroon, chocolate red calcareous sticky clay and claystone. Grey to white fine–grained to partly crystalline dolomites showing stylolitic structures. Dark grey to black foetid dolomite. Anhydrite & Gypsum. Pink, milky white to colourless halite. Halite withclay. Halite with polyhalite. Potash zone.
Neoproterozoic	Jodhpur Group	Reddish to maroon siltstone clay. Sandstone (reddish to pinkish greyish white to buff-coloured). Glauconitic sandstone. Calcareous sandstone. Grey cherty dolomitic limestone with chert & jasper

3.0.0 Description of different geological formations/rock types on the basis of subsurface exploration i.e. Amalgamated Shergarh-Sherawala- Ramsara-Dalmirkhera Block (South of proposed block,):

3.1.1 **Quaternary sediments:** The Quaternary sediments are represented by cyclic sequences of loose sand and silty clay. Within the cyclic sequences of sand and silty clay, at places kankar, black carbonaceous material, silty clay with small voids and thin carbonaceous impression are recorded. Small muscovite flakes were also recorded at few sand horizons. The pebbly horizons coarse sand and kankar represent high energy deposition which contains pebbly size sediment. These pebbly horizons are syn-depositional in nature. The clasts are consisting of quartz, sandstone fragments, limestone/calcretes and claystone fragments. The shape of clast is sub-angular to sub-rounded in nature.

In Punjab Evaporite Basin the thickness of Quaternary sediments increases towards north. As per subsurface geology, the Quaternary sediments overly the sediments of Tertiary period in some boreholes, however in others, the Quaternary sediments overly the rocks of Nagaur Group which indicates that sediments of Tertiary period are not well developed in the area. The contact between the Quaternary sediments and sediments of Tertiary period is gradational in nature. The sediments of Tertiary period comprise of friable/loose sand/sandstone and at places fragments of limestone and contact between Quaternary sediments and Nagaur Group of rocks is sharp in nature.

3.1.2 **Sediments of Tertiary period**: Sediments of Tertiary period are not well developed. The Tertiary sediments are represented by fragmented limestone within silty clay, gritty/friable sandstone, silty clay and clay. The clay is yellowish brown and variegated, having silt patches at places. The friable sand/sandstone is buff coloured, yellowish brown to light grey in colour and it varies from well to poorly consolidated. The contact of sediments of Tertiary period (sandstone) with underlying Nagaur Group (brick red claystone) is sharp in nature.

3.1.3 **Nagaur Group**: It is represented by brick red claystone, fine to medium grained sandstone, blotchy and bands of green clay within red clay. The predominant brick red colour of the rocks of the Nagaur Group indicates that the sediments represent continental facies and these sediments were deposited under very shallow-marine

conditions and had prolonged aerial exposure for intensive oxidation. The contact of Nagaur Group of rocks with underlying Evaporite Group is gradational in nature as the gypsum/anhydrite starts appearing in red shaly clay of Nagaur Group.

3.1.4 **Evaporite Group**: From the subsurface data of borehole, it may be inferred that in northern part of the Punjab Evaporite Basin, the thickness of top H7 halite cycle of Evaporite Group decreases in comparison with southern part of the basin. The sub-surface data of exploration reveals, that the deepest part of the Evaporite Basin is in southwest of Punjab Evaporite Basin. The Evaporite Group of rocks are lying in between the underlying Jodhpur Group of rocks and overlying Nagaur Group of rocks. Both the upper and the lower contacts are gradational in nature. The Evaporite Group of rocks are represented by turbid white halite, reddish orange, translucent halite, thinly laminated dolomite, reddish maroon claystone, Fine grained foetid dolomite, anhydrite, fibrous to crystalline halite, halite with impurities of anhydrite, halite with admixture of red clay and marl, reddish orange to pink halite. The cyclic halite deposits are separated from one another by intervening zone of clay and/or anhydrite and or dolomite.

The halite is greyish white, turbid white to reddish brown in colour, medium to coarse grained, crystalline and translucent in nature. Fluid inclusions were also observed in the translucent halite at place in all boreholes. At places thin blebs of anhydrite is associated with halite and occurs along crystal boundaries and fractures in halite. Anhydrite is mostly pink in colour and observed at various depth of borehole in Evaporite Group. Foetid dolomite or 'oil shale' (Special Publication no. 62, GSI, WR) is dark grey to black, thinly laminated, porous and vuggy. The vugs are filled with halite as secondary replacement. Thin laminations of light grey and black dolomite may indicate seasonal variations during deposition. Claystone is brick red in colour and is sometimes interlayered within the halite zone.

3.1.5 **Jodhpur Group**: Jodhpur Group of rock consists of sandstone of Terminal Neoproterozoic age. The sandstone of Jodhpur Group is considered as a basement for the Evaporite Group. The contact between Evaporite Group and Jodhpur Group of rocks is gradational in nature. The Jodhpur Group of rocks is represented by red to maroon, medium to fine grained sandstone and maroon claystone.

4.0.0 Structure

4.1.1 **Primary sedimentary structures** were observed in core. Primary sedimentary structure includes, primary bedding, laminations, and graded bedding.

4.1.1.2 **Bedding and laminations**: This is the most common primary sedimentary structures preserved in the drilled cores. In Nagaur Group, the thick, at places massive red clay is in contact with sandstone which indicates primary bedding. Bedding is horizontal to sub-horizontal. Cross lamination/current bedding is observed in the sandstone of Nagaur Group which indicates that the sediments were deposited in calm environment.

4.1.2 **Diastrophic structures**: Diastrophic structures are less preserved and observed in core. Diastrophic structure includes styolite.

4.1.2.1 **Styolites**: Styolites were recorded in anhydrite of Evaporite Group. These are formed due to diagenesis at a later stage due to compactness of sediments after the deposition of the evaporites.

4.1.2.2 **Stromatolites**: Stromatolites were also recorded in anhydrite of Evaporite Group This indicates that low order evaporites were deposited under shallow to moderately deep marine environment.

4.0.0 Mineralisation

4.1.0 The investigation area is covered by thick blanket of alluvium sediments of Middle Pleistocene to Holocene age. Hence, the surface indication for mineralisation is absent in the area. From the core logging, it is inferred that the basin is horizontal to sub-horizontal with dip of 2º -3º, at places dip amount 5º-28º was there due to local variations. In Evaporite Group (EG), seven cyclic deposits (H1 to H7) of halite, (mostly dominant constituent) containing potash minerals, alternating and separated by a sequence with anhydrite, clay, dolomite have been identified in all the drilled boreholes. Polyhalite/potash mineralisation is recorded in halite cycles thus, the whole potash mineralisation in Evaporite Group is sedimentary and strata bound in nature. Polyhalite is the main mineral of the potassium. The mineralization observed is in the form of bedded deposit. Polyhalite [K2MgCa2(SO4)4.2H2O] is very commonly associated with clay, anhydrite and halite. Zones of potash (K+) mineralisation have been delineated on the basis of chemical and XRD analysis of core samples of boreholes.

5.0.0 Proposed Exploration by MECL

5.1.0 Strategy

5.1.1 An unexplored area of 48.00 sq.km have been proposed as Choharianwali block for Reconnaissance Survey (G4) and the proposal has been prepared on the basis of the

exploration work completed so far in the nearby Amalgamated Shergarh-Sherawala-Ramsara-Dalmirkhera Block, Fazilka District, Punjab by GSI in the Punjab Evaporite basin. The basic idea behind it is to establish the continuity of Potash bands occurring in the nearby Amalgamated Shergarh-Sherawala-Ramsara-Dalmirkhera Block and its potentiality so that a new block for Potash can be established for auctioned and developed into a workable mine. A total of 15 no. of boreholes with a total of 14250 m of drilling in the area i.e. 48.00 sq. km has been proposed.

5.2.0 Objectives

The Reconnaissance Survey (G4) is proposed with the following objectives:

i) To confirm the continuity and potentiality of potash bearing zones in the proposed area.

ii) To generate data for assessment of mineralogy of the potash zones and the K contents.

iii) To estimate resources of Potash zones as per UNFC system in 334 Category.

5.3.0 Methodology of Exploration

5.3.1 Survey: Co-ordinates of the cardinal points and all the boreholes will only be determined by DGPS survey. Hence a total of 15 nos of boreholes and 4 Boundary points to be surveyed by DGPS.

5.3.2 Geological Mapping: Geological mapping on 1: 10,000 scale will be carried out in the entire block by taking geological traverses and all the geological/structural features will be recorded if any. This map will be the base map for future work.

5.3.3 Drilling: A total of 15 no. of boreholes (Phase I- six boreholes at 3200x3200m and Phase-II nine infilling boreholes at 1600x1600m grid spacing), which is suggested exploration scheme as per the MEMC 2015 (Amended upto 2021). A total of 14,250 m of drilling (each borehole of maximum 950m depth) in 15 nos. of vertical boreholes has been proposed in the block. The location of proposed boreholes is given as Plate No- III with proposed depth. The location of these boreholes may change slightly subject to approachability owing to terrain conditions.

The upper most formations i.e. Quaternary/Tertiary sediments or upto 450m from surface, whichever is earlier, shall be drilled by non-coring and Nagaur Group, Hanseran Evaporite Group and Jodhpur Group will be drilled by coring for all the 15 boreholes.

PHASE-I PROP. BHS AT 3200M GRID INTERVAL				
SL.NO.	BH.NO.	EASTING (M)	NORTHING (M)	PROP. DEPTH (m)
1	PBH-01	411444.8515	3365821.654	950
2	PBH-02	414636.0861	3365555.507	950
3	PBH-03	411178.8967	3362632.725	950
4	PBH-04	414371.5885	3362366.456	950
5	PBH-05	410912.9419	3359443.796	950
6	PBH-06	414107.0909	3359177.406	950
DRILLING METERAGE (M)				5700
PHASE-II PROP. BHS AT 1600M GRID INTERVAL				
7	PBH-07	413039.3133	3365688.644	950
8	PBH-08	411311.8417	3364227.192	950
9	PBH-09	412905.9232	3364094.246	950
10	PBH-10	414503.8373	3363960.981	950
11	PBH-11	412773.2963	3362499.753	950
12	PBH-12	411045.822	3361038.268	950
13	PBH-13	412640.2865	3360905.291	950
14	PBH-14	414239.3397	3360771.931	950
15	PBH-15	412506.991	3359310.853	950
DRILLING METERAGE (M)				8550
TOTAL DRILLING METERAGE (M)				14250

5.3.4 Geophysical Studies.

As per the existing exploration practice Dual Density, Neutron, Resistivity, Spectral Gamma and Caliper logging to be carried out in all the boreholes to identify location of fractures, conductive/mineralization zones, and subsurface lithology along the boreholes. Due to presence of borehole geophysical data of nearby blocks, the borehole geophysical logging shall be carried out in Nagaur Group, Hanseran Evaporite Group and Jodhpur Group only, i.e., bottom most 650 m for each bore hole. Hence in 15 boreholes (Phase-I six boreholes and Phase-II nine boreholes), a total of 9750m of geophysical logging for all the parameters will be carried out. Based on the geophysical interpretation, sampling of potash bearing zones shall be taken up.

5.3.5 Drill core Logging and Sampling

Detailed core logging will be carried out for all the boreholes and various details i.e., litho units/formations, intercalations and parting, core recovery, colour; structures and textures etc will be recorded. In the Hanseran Evaporite Group, special attention is required to identify Polyhalite and other Potash bearing minerals.

5.3.6 Sampling:

The primary samples will be drawn at the length of 0.50 m in the potash bearing zones depending upon the variation in the potash characteristics as well as 2.00m length interval in the non potash bearing Halite zones for both the Halite Cycles.

This will generate about 2250 no of Primary samples (Phase I -900 no and Phase -II 1350 no) for 11 radicals, K, Na, Water insoluble, Mg, Cl, Br, I, Li & CaSO4, F & B. Thus 225 no (10% of primary samples) external check samples (Phase I-90 no and Phase-II 135 no) will also be generated.

5.3.7 Laboratory Studies

Chemical Analysis:

a) All the Primary, External Check samples [2475 no; = 2250 Primary & 225 External Check (10%) of Primary samples will be analyzed for 11 radicals i.e. K, Na, Mg, Cl, Br, I, Li, F, B, $CaSO_4$ & Water insoluble.

b) X.R.D. Studies: X-ray Diffraction studies will be carried out on the primary samples of potash zones which will be about 375 nos. (Phase-I 150 no and Phase-II 225 no) to identify the different mineral phases occurring in the mineralized zones.

c) Specific gravity determination: Specific Gravity will be determined on 30 nos. (Phase-I 12 no and Phase-II 18 no) drill core specimen of halite.

d) Complete petrographic/ore microscopic study/mineragraphic report of rock sample (along with 5 nos. digital photo micrographs)- Petrographic studies will be determined on 10 nos. (Phase-I 03 no and Phase-II 07 no)

5.3.8 Exploration Report: Data generated from proposed exploration along with integration of earlier data of GSI will be utilized in Report preparation.

5.3.9 Quantum of work:

The quantum of work proposed in the present exploration scheme is given in Table below:

Quantum of work proposed for Potash Exploration in Choharianwali block, Punjab Evaporite Basin, Fazilka District, Punjab

Sl. No.	Item of work	Unit	Quantum
1.	Geological Mapping on 1:10,000 scale	Sq. Km.	48.00
2	DGPS survey of 15 Nos of BHs, 4 boundary points	Nos	19
3.	Drilling: i) 15 boreholes (Phase-I 6 BHs and Phase II 9 BHs)	m.	14250 m (15 BHs)
4.	Geophysical Studies		
	i) Borehole Geophysical Logging (Phase-I 6 BHs and Phase II 9 BHs) Dual Density, Resistivity, Spectral Gamma, Neutron & Caliper	m.	9750 m (15 BHs)
5.	**Laboratory Studies**		
	A. Primary + Check Samples		
	i. **Primary samples** for 11 radicals i.e. K, Na, Mg, Cl, Br, I, Li, F, B, $CaSO_4$ & Water insoluble (Phase I -900 no and Phase -II 1350 no)	Nos.	2250
	ii. **External check samples** (10% of Primary samples) for 11 radicals i.e. K, Na, Mg, Cl, Br, I, Li, F, B, $CaSO_4$ & Water insoluble from External NABL Lab (Phase I-90 no and Phase-II 135 no).	Nos.	225
	iii. X-Ray Diffraction Studies (Phase-I 150 no and Phase-II 225 no)	Nos.	375
6.	Specific Gravity Determination (Phase-I 12 no and Phase-II 18 no)	Nos.	30
7.	Report Preparation (Digital Format)	Nos.	1

6.0.0 Manpower Deployment

6.0.1 Manpower deployment List may be provided later.

7.0.0 Time Schedule and Cost Estimates:

7.1.0 Time Schedule: The proposed exploration programme like drilling, Geology, Laboratory work including Camp setting & winding and Laboratory studies will be completed in 18 months' time. Report writing will take additional 3 months including 1 months overlap with laboratory studies. Thus, the total time proposed for

completion of work is **21months**. The bar chart showing Action Plan/time schedule is given in Annexure-I.

7.2.0 Cost Estimate: Cost has been estimated based on new rates of SOC of NMEDT dated 04.12.2025. The total estimated cost is **Rs 1997.59 lakhs**. The details of cost estimates are given in Annexure-II and summary is given below.

Summary of Cost Estimates

Summary of Activity wise Cost Estimates		
Sl. No.	**Activities**	**Estimated Cost (Rs.) - G4 level**
1	**Geological work**	**1,01,51,400**
2	**Mineral Investigation (Drilling & Pitting-Trenching)**	**11,14,50,000**
3	**Laboratory studies (Chemical Analysis,Physical & Petrological Studies & Geotech. Lab)**	**4,64,05,500**
Sub-Total		**16,80,06,900**
4	**Proposal Preparation**	**5,00,000**
5	**Geological Report Preparation**	**7,50,000**
6	**Peer review charges**	**30,000**
Total		**16,92,86,900**
7	**GST (18%)**	**3,04,71,642**
Total Cost including 18% GST		**19,97,58,542**

8.0.0 Justification:

8.1.1 On enactment of amended MMDR rule, the critical minerals are being auctioned by Central Government. The previously explored Jaitpur, Lakhasar, Bharusari and Satipura blocks explored by GSI and MECL for potash in Nagaur-Ganganagar Basin in the North Western Rajasthan are already on the auction platform. The Amalgamated Shergarh-Sherawala-Ramsara-Dalmirkhera Block, Fazilka District, Punjab in the Punjab Evaporite Basin (north extension of Nagaur-Ganganagar Basin) is already on the auction platform in the VIth Tranche of Critical Mineral block auction by Ministry of Mines, Govt. of India.

8.1.2 The Punjab Evaporite Basin (PEB) falling in southwestern Punjab is only partially explored. Geologically the area comprises older alluvium and aeolian sediments of Middle Pleistocene to Holocene age. All seven halite cycles, numbered H1 to H7 from bottom to top have been intersected in all the boreholes drilled by the GSI in the

Amalgamated Shergarh-Sherawala-Ramsara-Dalmirkhera Block.

8.1.3 In the Amalgamated Shergarh-Sherawala-Ramsara-Dalmirkhera Block, Fazilka District, Punjab resource for Potash (K2O) with average grade is estimated at 2%, 5% and 8% cut-off grade and halite is estimated at 31.47% cut-off for this amalgamated block. This Block is bounded by co-ordinates (A= 30.054544 N: 74.032906 E, B= 30.055348 N: 74.085264 E, C= 29.972995 N: 74.086429 E and D= 29.973284 N:74.033732 E). Out of eight boreholes drilled from FS 2019-21 to FS 2022-24, six boreholes (PFSBH-02, PFSBH-04, PFSBH-05, PFSBH-06, PFSBH-07, PFSBH-08) are taken in to consideration with an area of 45.929669 Sq km (4592 Hectare).

8.1.4 K2O resource is estimated to be 281.448000 MT with avg. grade of 3.72 % K2O based on 2% cut off, 34.344000 MT with avg. grade of 7.42 % K2O based on 5% cut off and 12.960000 MT with avg. grade of 9.56 % K2O based on 8% cut off. Halite resource for this Block is calculated to be 2442.17 MT with 35.18% in natural cut-off.

8.1.5 In order to establish the sub-surface lithology and lateral continuity of the potash bearing halite cycles in the Choharianwali block, the boreholes need to be drilled in grid spacing as the block lies in the Punjab Evaporite Basin (Northern fringe of the Nagaur-Ganganagar Basin).

8.1.6 In view of the above, it is imperative that the halite cycles and the potash zones established in the Amalgamated Shergarh-Sherawala-Ramsara-Dalmirkhera Block may show continuity and consistency throughout the Punjab Evaporite Basin. Hence the Choharianwali block in the northern side of the Amalgamated Shergarh-Sherawala-Ramsara-Dalmirkhera Block within Punjab Evaporite Basin need to be explored on 1600m X 1600m grid so that potentiality of the block can be established and can be auctioned and developed in to potash mines to meet the rising demand of the fertilizer mineral.