



Directorate.....

of Intelligence.....

Intelligence Memorandum.....

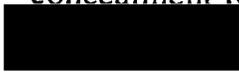
Office of Resources, Trade, and Technology.....

7 July 1992.....

Tuzla, Bosnia and Hercegovina: A Review of Geographical Realities

Summary

Two geographic factors are key considerations in analyzing the risks involved in military operations in the Tuzla area:

- o A large chemical plant is located in the western part of the city and the 500 tons of chlorine gas stored there could kill people as far as 20 kilometers away if it were quickly released when the winds were light, according to the US Environmental Protection Agency. Tuzla's summer winds are light and often come from the west, and its terrain could funnel the chlorine gas through the city.
 - o The city's location in a narrow valley makes it and the roads approaching it vulnerable to sniper fire from the surrounding hills, which can also serve as artillery and mortar positions. The hills and mountains around the city typically have forested crests, which could provide concealment for personnel and equipment.
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Tuzla, Bosnia and Hercegovina: A Review of Geographical Realities

Key Considerations

Chemical plant in Tuzla

A large chemical plant is located on the western outskirts of Tuzla. The chemicals stored at the D.D. Polihem Chemical Plant could pose a grave threat if the plant were sabotaged or badly damaged, and all the gas were released at once. Many of the chemicals are flammable, corrosive, or toxic--or could become toxic if they were released and mixed in the atmosphere.

if all the chlorine in storage were released when winds were calm or light,¹ the chlorine could cause widespread death up to 20 kilometers (km) from the plant. Tuzla's location in a valley means that gas released from the plant could be funnelled up the valley by the wind, right through the city. Over 230,000 people live within a 20 km radius of the plant.

Natural Terrain

The natural terrain surrounding Tuzla makes it vulnerable to flat-trajectory fire, including sniper fire, while the hills surrounding Tuzla can serve as artillery and mortar positions. Tuzla lies in an east-west trending valley at an elevation of about 240 meters (m). It is surrounded by rolling hills that increase in height to the east. The hills and embankments near the city center are about 50 m higher than the city, while local peaks with a clear line of sight to the valley--and the highways that serve it--are about 100 m higher than the valley floor. The hills rise eastward for about eight km, cresting at over 840 m at Mt. Medednik, the highest peak in the Majevisa Mountains. These mountains mark the boundary between the mountain section of Bosnia and Hercegovina and the broad plain of the Sava River, which drains into the Danube River.

The valley bottoms and lower hillslopes around Tuzla are covered by cropland. Steep slopes and hillcrests are covered by deciduous forest. These patches of discontinuous forest could provide concealment for personnel and equipment. Strips of trees along the field boundaries could also provide some concealment throughout the cropped areas, as could the numerous small orchards. The Majevisa Mountains support an extensive forest along their crest.

¹ Calm or light winds enable gas clouds to remain intact and gas concentrations to remain high. Stronger winds mix fresh air into the gas and dilute it. The impact of a gas release would be most severe in early morning, with its light winds, cooler temperatures, and higher humidity.

Tuzla's valley is less than a kilometer wide and cut by the narrow, twisting Jala River. Numerous tributary streams drain side valleys and flow into the Jala. In Tuzla, the Jala is confined to an artificial channel with moderately steep walls. This channel could be an impediment to easy movement if the bridges were destroyed. The Jala joins the Spreca River--a tributary of the Sava River--about 12 km downstream from Tuzla. [REDACTED]

Geographic Background

Tuzla (4433N 01841E) is located about 150 kilometers (km) west of Belgrade and 80 km north of Sarajevo. It is only 40 km west of the border between Bosnia and Hercegovina and Serbia, and 40 km south of the border between Bosnia and Hercegovina and Croatia. [REDACTED]

The Tuzla area has a population of around 135,000 people. In the 1981 Yugoslav census, 43 percent of the population was Muslim, 20 percent was Croatian, and 17 percent was Serbian. By late June, Tuzla sheltered about 35,000 refugees. Over 230,000 people live within a 20 km radius of Tuzla. [REDACTED]

Climate

Tuzla's location at the northern end of the mountainous highlands of Bosnia and Hercegovina has a significant impact on its climate. Being protected from the prevailing winds by the mountain belt to its west, Tuzla experiences less cloudiness and precipitation than most of the western areas of Bosnia and Hercegovina. The mountains also moderate the temperatures. In the winter, the intense storms that approach the Balkans from the Adriatic Sea are deflected away from Tuzla towards the southeast by the coastal mountains. [REDACTED]

Temperature. In July and August, average daily high temperatures are below 75 degrees Fahrenheit (F) and rarely exceed 90 degrees F, while the average daily low temperatures are around 62 degrees F. In the winter, average daily temperatures in winter drop from 41 degrees F in November to 32 degrees F in January. [REDACTED]

Precipitation. The spring and summer months are the wettest months of the year in Tuzla. July receives almost 3.8 inches and August slightly more than 4.1 inches. Thunderstorms occur on four to five days a month from May through August but only occasionally during the rest of the year. Snowfall occurs from November through April, with an annual average of just over 40 inches. [REDACTED]

Wind. Surface winds are light throughout the year. The prevailing winds from April through August are from the west and average three or four knots. The average windspeed when all wind directions are considered is only one knot. From September through March the prevailing winds are from the northeast but still average only three knots, and average only one knot when all winds are included. [REDACTED]

Transportation

Highways. Tuzla is accessible by road, but the highways that serve it are two-lane and pass through forested hills and valleys that could provide cover and concealment for possible attackers. The main highway through the center of Tuzla is Highway 18. Other highways join Highway 18 on either end of the city. An old network of twisting, narrow roads weaves through the countryside and across the mountains. It is still heavily used by local residents. [REDACTED]

Roads leading east from Tuzla. Highway 18 is one of the area's newer highways and heads east from Tuzla towards Bijeljina, eventually leaving the valley on a route with hairpin turns near the mountain crest. A second route east from the Tuzla area does not pass through Tuzla proper but can be reached by going south on Highways 18 and 4 about eight km to Zivinice. At Zivinice, Highway 4 diverges from Highway 18, staying in the Spreca Valley and running just north of the Tuzla Airfield. It runs along the western flanks of the Majevisa Mountains, eventually crossing them and reaching Zvornik, in the valley of the Drina River. [REDACTED]

Roads leading north from Tuzla. The main road north from Tuzla is Highway 1d. Relatively new, it joins Highway 18 on the western outskirts of Tuzla, beyond Tuzla's industrial district. As it generally follows a rail line, it has a low gradient across the mountains for most of its route, which terminates at Vukovar on the Sava River. Highway 4, an older route, follows the main valley of the Jala northwest to the Spreca River valley and then follows the Spreca valley to Doboj, where it intersects Highway 17, which follows the Bosna River north through the mountains towards the Sava. Another old road north from Tuzla splits from Highway 18 east of town at Simin Han and passes through Gornja Tuzla. The twisting road crosses the mountains one pass to the north of Highway 18, traversing the flanks of Mt. Medednik. It exits the mountains at Celic and passes through Brcko. [REDACTED]

Roads leading south from Tuzla. The main road from Tuzla to Sarajevo cuts south from the Jala River valley at the western end of Tuzla. Although a continuation of Highway 1d, its number changes to Highway 18. It passes through Zivinice. [REDACTED]

Railroads. Tuzla is served by a standard gauge rail spur line that comes up the Spreca River Valley from Doboj. The line's junction at Doboj connects the Tuzla spur with the main line between Sarajevo and the northern plains. A second railroad line runs from Tuzla to Brcko, crossing the mountains through a low pass. Narrow gauge railroads lead south from Tuzla to mining districts to the south. [REDACTED]

Airfield. Tuzla Airfield (4427N 01843E) is the only airfield in the Tuzla area. It is located almost 10 km south of Tuzla, beyond the forested hills that rise south of the Jala River. [REDACTED]

Tuzla Airfield's single concrete runway is paralleled on one side by a taxiway and on the other by a sod strip. [REDACTED]

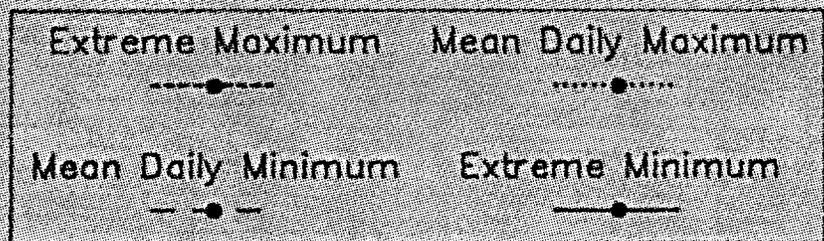
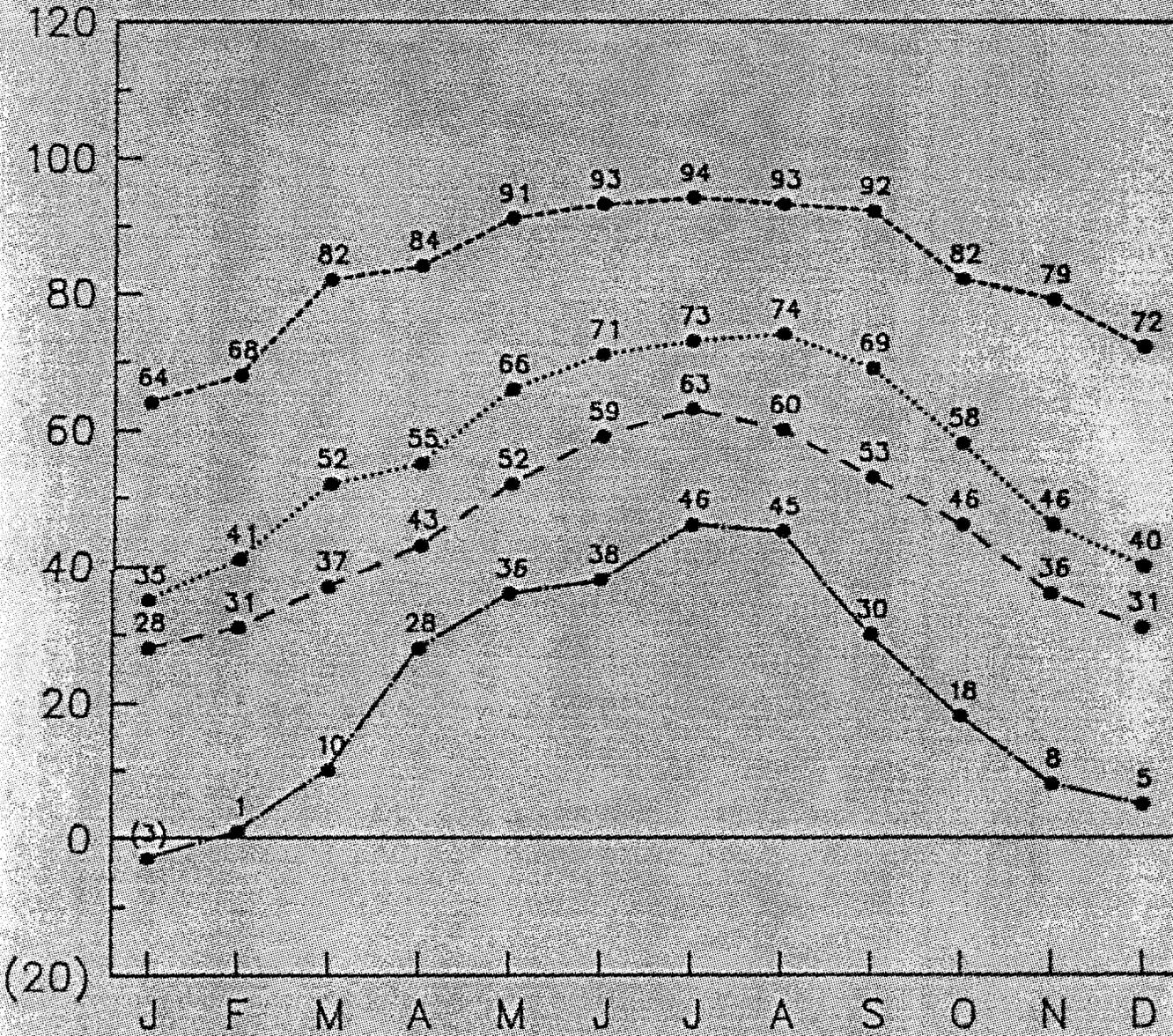
Northeastern Bosnia and Hercegovina



TUZLA, BOSNIA AND HERCEGOVINA

Monthly Temperatures

Degrees Fahrenheit



Roads to Tuzla Airfield. Tuzla Airfield can be reached from Tuzla by using either the main highways or local roads. Highway 4 east of Zivinice passes to the north of the Airfield. A local road leaves from the center of Tuzla and heads south directly towards the Airfield. Another local road splits from Highway 18 upstream from Tuzla, and circles eastward around the row of hills south of the Jala, joining Highway 4 east of the Airfield. [REDACTED]

Other Considerations

Food Supply

Although the area surrounding Tuzla is agricultural, the region imports grain, meat, sugar, oils, and canned goods. Bosnia normally imports over 50 percent of its food from Serbia and Croatia, but Serbia cut off food exports in December, and shortages were reported in Bosnia shortly afterward. Croatia--which previously would have been able to fill the gap--has lost much of its best cropland to Serbia and has announced that it will not have enough surplus food to export to other republics. Local production of fruits and vegetables in the Tuzla area has almost certainly been disrupted by the conflict, reducing the supply available in the summer. Although some hoarding has undoubtedly taken place, the amount stored privately in Tuzla is unknown. [REDACTED]

Important Urban Areas

Tuzla is the largest population center in the area. Most of the town lies between the Jala River and the highway that parallels it at the edge of the valley. Newer parts of the city have been built in side valleys and on the tops of the hills that rise above the main part of town. [REDACTED]

Tuzla has been subject to mortar and artillery fire since mid-May. The pace of the fire has increased, and on the night of 27 June 200 rounds fell on the city, causing massive damage, according to the press. Prior to that, press reporting indicates that the shelling was confined to the eastern end of town, a residential district with numerous high-rise apartment buildings. [REDACTED]

Important Rural Areas

The rural areas near Tuzla are densely settled and many villages have been the scene of fighting. Press reporting suggests that some villages to the north and east of Tuzla have been used as artillery positions from which to fire on Tuzla. Gornja Tuzla has been destroyed, according to the press, and Lukavac has experienced frequent fighting. [REDACTED]

Lukavac is the most important community near Tuzla. Located on Highway 4 in the Spreca Valley, it is an industrial town that produces caustic soda, cement, and coke. According to the 1981 census, the population of Lukavac and its immediate area was 54,666, of which 64 percent were Muslim and 22 percent were Serbian [REDACTED]

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D.D. Polihem Chemical Plant, Tuzla, Yugoslavia
Storage capacity, hazardous and toxic substances

Substance	Storage, in tons	
	Capacity in plant	Quantity on site ^a (18 May 1992)
Chlorine	360	500
Sodium chlorate	20	220
Sulfuric acid	180	130
Mercury	54	54
Hydrochloric acid	460	000
Sodium hypochlorite	250	450
Ethylene oxide	150	NA ^b
Propylene	950	22
Propylene oxide	120	8
Adipynic acid	15	15
Sodium hydrochloride	750	NA
Sodium hydroxide	NA	500
Di-nitrotoluene (DNT)	30	NA
Toluene	400	500
Toluene di-isocyanate (TDI)		315

^a Includes storage in rail cars on plant grounds. 

^b Not available

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Tuzla Airfield and Landing Strips

Location	Runway Number/ Azimuth	[REDACTED]	Comments
Tuzla 4427N 01843E	080/260	[REDACTED]	Airfield abandoned by JNA in May 1992
	080/260 (auxiliary)	[REDACTED]	parallels main runway on south side
Tuzla Highway 4428N 01846E	100/280 (unmarked)	[REDACTED]	Auxiliary landing strip for Tuzla Airfield
Zivinice Highway 4426N 01841E	120/300	[REDACTED]	Auxiliary landing strip for Tuzla Airfield

TUZLA, BOSNIA AND HERCEGOVINA

Climatic Surface Winds

Knots

	Prevailing Direction	Mean Speed (Prvlg Dir)	Mean Speed (All Dir)
January	NE	3	1
February	NE	3	1
March	NE	3	2
April	W	4	2
May	W	3	1
June	W	3	1
July	W	3	1
August	W	3	1
September	NE	3	1
October	NE	3	1
November	NE	3	1
December	NE	3	1