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# Comparative Assessment of Physico-Chemical Parameters of Surface and Ground Water of River Chambal at Kota District Rajasthan

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**ABSTRACT:** Over the past few years, deterioration in water quality has gradually rendered the Chambal River water unfit for various beneficial purposes and to sustain and restore the wholesomeness of river water in terms of its ecological sustainability is the logical necessity of today. The River Chambal passes through the City Kota, an educational and industrial city of Rajasthan state and due to various types of anthropogenic activities its water gets contaminated in the area. Although the self-purification characteristics of river reduce pollutants at measurable extent but undesired substances add to the water at proportionally higher rate and exert impact on physico-chemistry of water making it unsafe and unfit for intended purpose. Being the problem concerned with health of every one, it was considered worthwhile to carry out physico-chemical study of River Chambal by determining various parameters for water quality along with Kota City area during pre-monsoon, monsoon and post monsoon seasons of the years 2017 and indicated its suitability for intended purpose. The overall water quality of River Chambal was observed moderately polluted in City area in all monsoon period.

### I. INTRODUCTION

Rivers Chambal plays a major role in integrating and organizing the landscape, and moulding the ecological setting of a basin. They are the prime factors controlling the global water cycle and in the hydrologic cycle, they are the most dynamic agents of transport. Riedel<sup>1</sup> et al. examined the spatio-temporal variation in trace elements in Patuxent River, Maryland, while Sileika<sup>2</sup> et al. reported the variations in nutrient level in the Nemunas river of Russia. Schaefer and Alber<sup>3</sup> studied nitrogen and phosphorus in Altamaha river, Georgia, while Quadir<sup>4</sup> et al. studied the Nullah Aik, a tributary of the river Chenab. Gupta<sup>5</sup> and Chakrapani studied the Narmada river basin; and Sundaray<sup>6</sup> et al. the Mahanadi basin. Among Indian rivers, those flowing through the Indo-Gangetic Plains are the most studied. Subramanian<sup>7</sup> documented inconsistent down-stream variations in river water chemistry. Among Indian rivers, those flowing through the Indo-Gangetic Plains are the most studied. Subramanian<sup>7</sup> documented inconsistent down-stream variations in river water chemistry. Singh and Singh<sup>8</sup>, documented the physical, chemical and biological aspects of the Ganga river. Heavy metals such as Cr, Mn, Fe, Co, Ni, Cu, Zn, and Pb in the sediments of the Ganga river basin have been analysed. There are several studies on the tributaries of the Ganges, including the rivers Yamuna, Gomti and Hindon documenting different physico-chemical aspects. The present study focuses on the river Chambal that flows through heart of the Kota City, one of the prominent industrial and educational town of Rajasthan state in India, catering to the needs of several millions of people. The river is currently facing tremendous pressure due to encroachments, discharge of untreated domestic and industrial waste, dumping of solid waste and illegal diversion of water. However, the river remains less examined with regard to important base-line information. This paper focused on the present pollution status of river Chambal which is determined by analyzing few of the physico-chemical parameters. In continuation of our previous work<sup>9-11</sup>, we have analyzed the various physico-chemical parameters of river Chambal.

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## II. MATERIAL & METHODS

The samples of water were collected from different places of the river Chambal in Kota City. These samples were collected periodically from January 2017 to December 2017. Water samples were collected in different glass bottles. Physicochemical parameters for the collected samples were studied by international standard methods. Distilled water was used as a Control Sample. The water quality parameters were analysed as per standard methods supported by<sup>12-14</sup>. For analysis of each sample, three replicates were used.

## III. SAMPLING TECHNIQUES AND ANALYSIS

For this purpose ten locations and four points at each location were chosen along the river Chambal in Kota City, Kota. Samples were collected in sterilized polypropylene bottles using standard procedure of grab or catch as per the methods of APHA<sup>15</sup> (1985) in pre-monsoon, monsoon and post monsoon season of the years 2017. Physicochemical parameters such as pH, conductivity, total dissolved solids, dissolved oxygen, chemical oxygen demand and biological oxygen demand were selected and estimated quantitatively as per standard methods & procedures of APHA<sup>15</sup> (1985). All the chemicals used were of AR grade used for this purpose. Details of the analysis methods are summarized in Tables.

## IV. RESULT AND DISCUSSION

### 1. Temperature

The results from analyses of water temperature from surface and ground water as presented in table 1.1 and figure 1.2 reveals that the temperature of the surface and ground water samples are within the permissible limit as per IS:10500. The results reveal that in months of October to March the temperature varies from 10°C to 20°C whereas in the months of May to September the temperature of surface and ground water samples varies from 20°C to 30°C. It is clear from the graph that temperature is low in the month of January, slight rise is observed in each month and the highest temperature is observed in the month of May to August after which decreasing trend is observed. The observed trend of rise and fall of temperature in water samples is due to change in atmospheric temperature or seasonal temperature change.

Increased water temperature is an important consideration when toxic substances are present in water. Many substances (i.e. cyanides, phenol, xylene, zinc) exhibit increased toxicity at elevated temperatures. These toxicities and other physiological interactions are also influenced by temperature acclimation or history of the species.

Table 1.1: Average monthly Temperature (°C)

Month	Surface Water	Ground Water
January	12.3	15.2
February	14.2	17.1
March	18.4	20.1
April	25.2	21.2
May	30.1	23.8
June	27.3	24.2
July	25.1	24.1

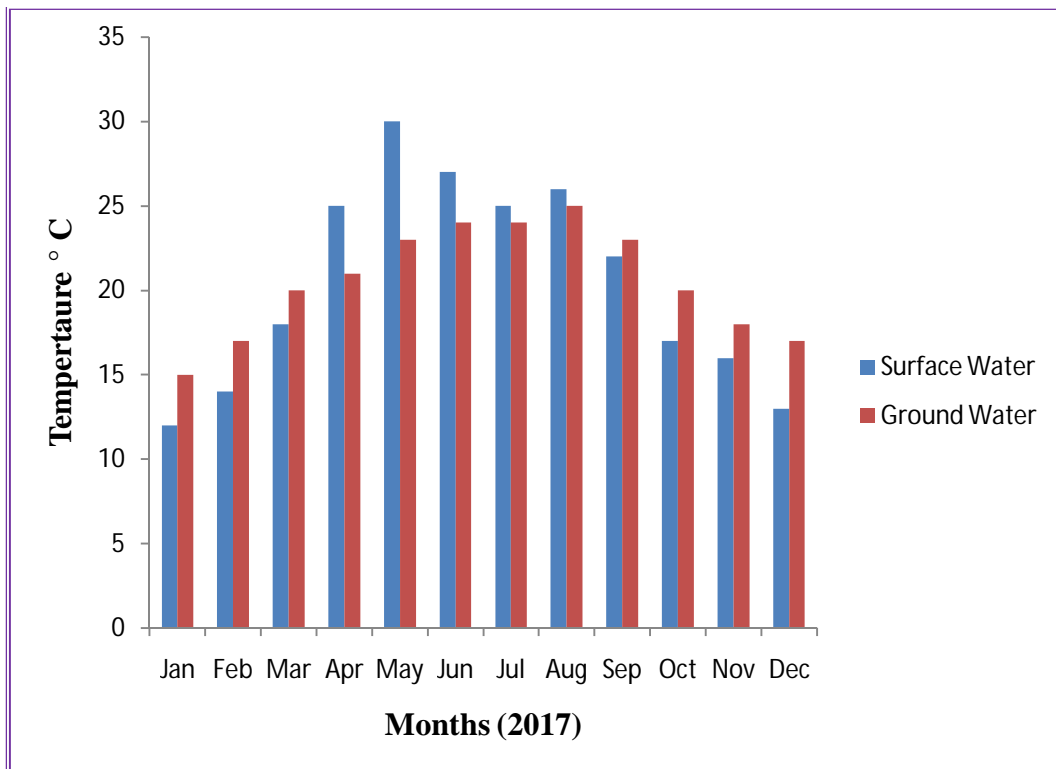
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August	26.3	24.9
September	21.9	23.1
October	17.0	20.7
November	16.1	18.2
December	13.1	17.1



**Figure 1.2: Average monthly temperature values of the surface and ground water samples**

### 2. pH VALUE

The pH is a measurement of the intensity of acidity or alkalinity and also measures the concentration of hydrogen ions in water. It has no direct adverse affect on health, however, a low value, below 5.0 will produce sour taste and higher value above 8.5 shows alkaline taste. A pH range of 6.5 – 8.5 is normally acceptable as per guidelines suggested by IS: 10500. The results of the analyses for the collected surface and ground water samples are presented in table 2.1 and figure 2.2

The analyses results as presented in table 2.1 and figure 2.2 reveals that pH values for surface water samples are comparatively high as compared to the ground water samples except for the months of July and August. The fluctuation in the months of July and August may be due to precipitation. However result reveals that the surface water samples are close enough to alkaline this is due to the contamination in the surface water. The contamination in the surface water is due to intrusion of untreated sewage water, domestic waste, addition of industrial waste from nearby surroundings.

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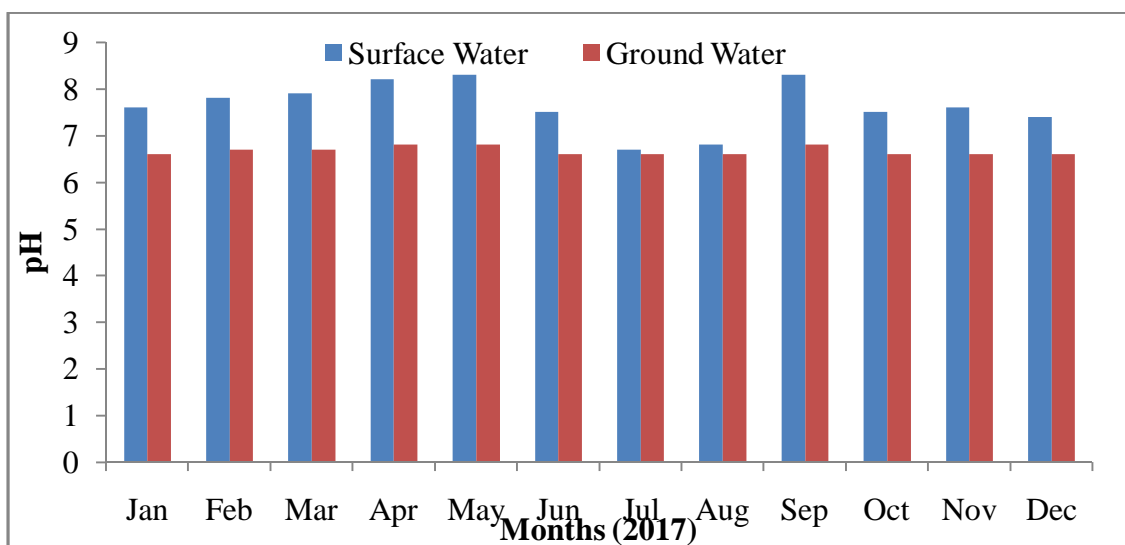
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However it is clear that the contaminated surface water will have a negative impact on ground water too in coming years.

The increase in pH level of the surface water will also have adverse impact on the aquatic life too directly. It can also be never neglected that if aquatic life or aquatic process is hampered the self-purification mechanism of water will also be hampered.

**Table 2.1: Average monthly pH values of the surface and ground water samples**

Month	Surface Water	Ground Water
Jan	7.5	6.5
Feb	7.7	6.7
Mar	7.8	6.6
Apr	8.1	6.7
May	8.2	6.7
Jun	7.4	6.5
Jul	6.6	6.5
Aug	6.7	6.5
Sep	8.2	6.7
Oct	7.4	6.5
Nov	7.5	6.5
Dec	7.3	6.5



**Figure 2.2: Average monthly pH values of the surface and ground water samples**

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### 3. TURBIDITY

The analysed results for turbidity are presented in table 3.1 and figure 3.2 Measurement of Turbidity reflects the transparency in water. It is caused by the substances present in water in suspension. In natural water, it is caused by clay, silt, organic matter and other microscopic organisms.

The prescribed limit of Turbidity for drinking water is 5-10 NTU (IS: 10500). Turbidity was found within the permissible limit in all the water samples. However for case of surface water samples turbidity was high whereas turbidity was found low in ground water samples. The result reveals that in ground water samples turbidity varied from 6 to 6.5 that is permissible limit for drinking water whereas in surface water samples turbidity varied from 8 to 9. Thus surface water is unlike to be suitable for drinking purpose. The reason behind the high level of turbidity is due to contamination in the surface water. Additional domestic and industrial waste dumping along with stream flow and runoff from the neighbouring area are major source of high turbidity in surface water.

**Table 3.1 : Average monthly turbidity for surface and ground water samples**

**Table 3.1 Average Monthly Values of Turbidity (NTU)**

Month	Surface Water	Ground Water
January	8.7	6.3
February	8.6	6.2
March	8.7	6.1
April	8.6	6.3
May	8.7	6.3
June	8.7	6.2
July	8.3	6.2
August	8.8	6.1
September	8.7	6.1
October	8.6	6.3
November	8.5	6.4
December	8.6	6.4

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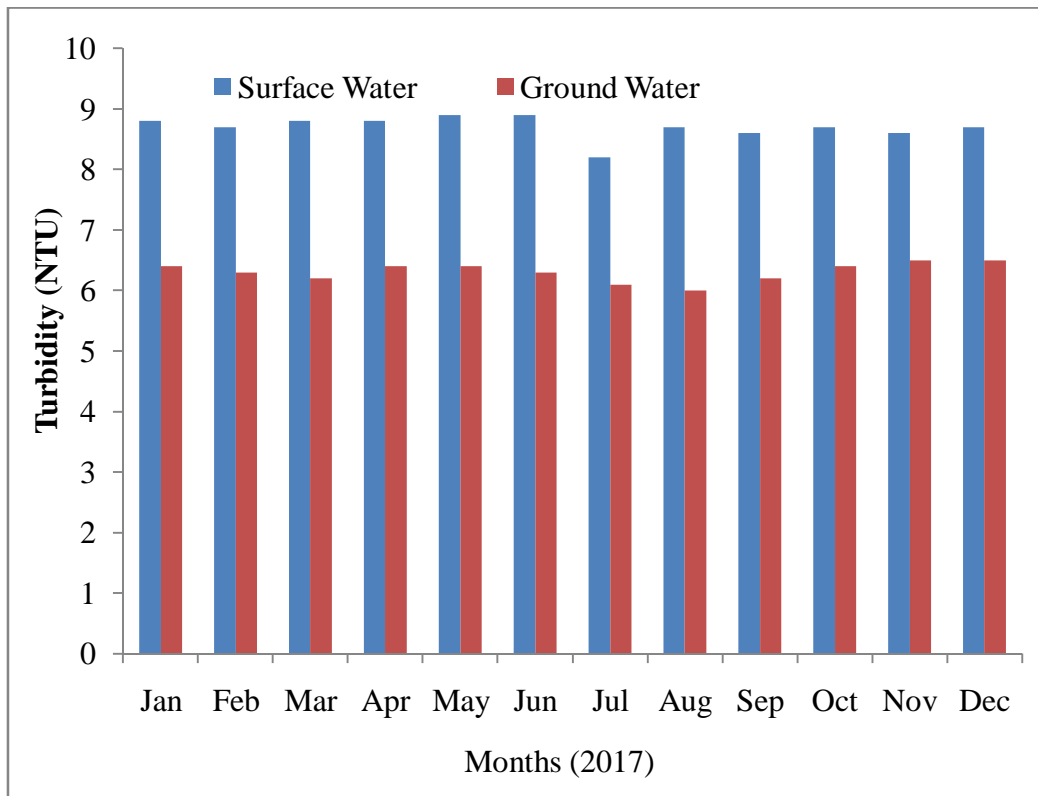


Figure 3.2 : Average monthly turbidity for surface and ground water samples

The direct runoff from the agricultural field in the catchment area of the river carries the organic and chemical wastes with the water and adds to the contribution of contaminations in the surface water and finally through deep percolation it reaches to the ground water.

The excess of turbidity has less impact on elders but it has a notable health issues on infants. Various breathing disorders have been identified in the areas of having high turbidity in the drinking water. However water application of high turbidity in agricultural fields does not have instant negative impact but in long term it has adverse impact on soil health.

#### 4. TOTAL DISSOLVED SOLIDS

Total Dissolved Solids may be considered as salinity indicator for classification of surface and groundwater. The TDS in groundwater is due to the presence of Calcium, Magnesium, Sodium, Potassium, Bicarbonate, Chloride and Sulphate ions. The results of the analyses are presented in table 4.1.

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**Table 4.1 Average monthly values of Total Dissolved Solids (mg/l)**

Month	Surface Water	Ground Water
January	515.3	419.2
February	518.2	423.1
March	514.3	422.3
April	513.3	420.3
May	515.2	421.2
June	506.7	412.6
July	502.1	410.2
August	500.3	410.3
September	505.2	412.5
October	507.3	411.6
November	508.3	415.3
December	512.4	417.9

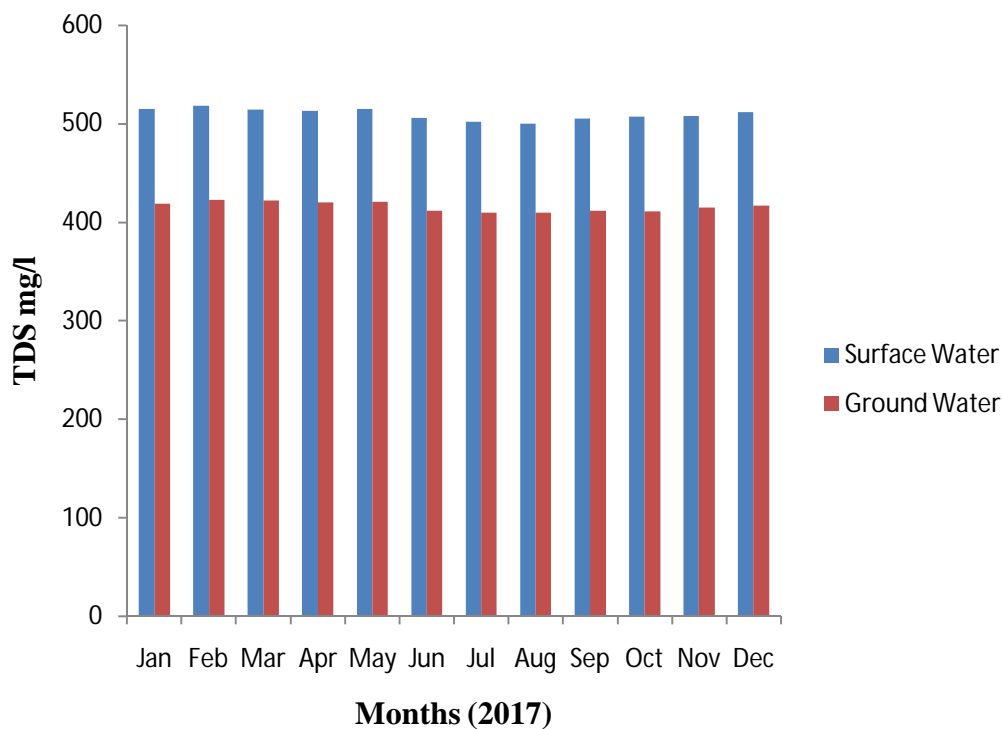


Figure 4.2 Average monthly values of Total Dissolved Solids (mg/l)

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Analysis results for TDS in surface and ground water samples shown in table 4.1 and figure 4.2 reveals that the ground water samples are found to be appropriate but near to the permissible limit. TDS in surface water samples were found on end limit. TDS for surface water samples varied from 580 to 510 mg/l. Highest TDS were found for the surface water samples in the month of January and February. Domestic waste disposal is the main reason of high TDS in the surface water samples. As prescribed limit of TDS for drinking water is 500 mg/l. However TDS were almost same in ground water samples throughout the year and varied from 510 to 515 mg/l.

### 5. HARDNESS

Hard water does not allow the soap to produce foam and hence is not suitable for household purposes. Permissible value of Hardness for drinking purpose is 300mg/l (IS:10500). According to Hardness classification soft water is considered to have TDS 0-60mg/l, moderately hard water to have TDS 60-120 mg/l, hard water to have TDS 120-180mg/l and very hard water to have TDS value of 180mg/l and above. The results from table 5.1 and figure 5.2 reveal that the surface water quality of chambal River is not suitable for drinking purpose. The surface water was found to be very hard (in the range of 284 mg/l to 288 mg/l) but the values of hardness of ground water samples were found under appropriate limit (in the range of 86 mg/l to 92 mg/l). The hardness of surface water can have a negative impact in ground water quality. The reasons for hardness of surface water samples are the toxic and chemical waste intrusion through sewer lines, additional chemical transport through seepage from agriculture fields, etc.

**Table 5.1 Average monthly values of Hardness (mg/l)**

Month	Surface Water	Ground Water
January	286.3	89.1
February	285.3	87.5
March	284.2	92.2
April	286.2	91.2
May	285.3	90.3
June	284.3	89.2
July	287.1	87.4
August	288.2	86.5
September	286.7	89.5
October	287.4	91.2
November	285.3	90.1
December	284.5	88.5

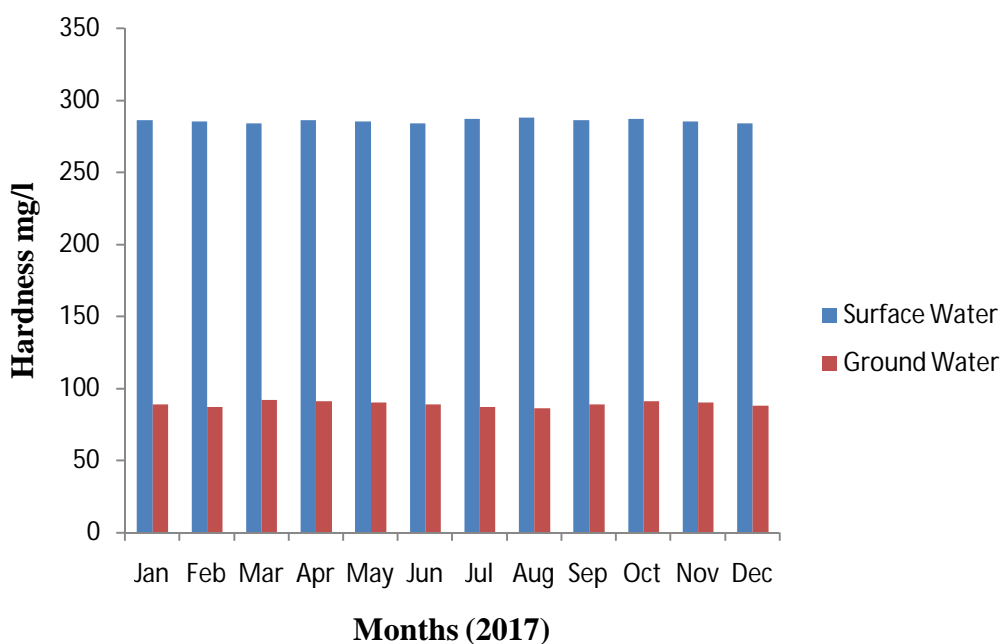


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### V. CONCLUSION

The analysed data for the year 2017 reveals that the water quality at ground water is fairly satisfactory during this entire period. Sometimes few parameters have recorded high values of pollution indicating temporary sign of pollution which may be due to some localized affect. The water quality at the Sanctuary fairly satisfies the water quality criteria for Class C waterbody (Drinking water source after conventional treatment and disinfection) at almost all the instances. The overall health of the river during all the years has been found fairly satisfactory. But the water quality of surface water is not satisfactory. The present study recommends to continue the monitoring that is useful for the sustainable development through planning and for the implementation of remediation methods in the future, in order to mitigate the adverse effects of the deprived quality of river water on human health, as well as on plant growth.

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