

NEW JERSEY STATE DEPARTMENT OF TRANSPORTATION

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ENVIRONMENTAL ANALYSIS AND REPORT  
FOR  
ROUTE 18 FREEWAY EXTENSION  
CITY OF NEW BRUNSWICK AND PISCATAWAY TOWNSHIP  
MIDDLESEX COUNTY, NEW JERSEY

VOLUME II - APPENDIX  
SECTION 6 - METEOROLOGICAL REPORT

PREPARED BY

PROF. A. VAUGHN HAVENS

FOR

KING & GAVARIS  
CONSULTING ENGINEERS

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WEATHER CONDITIONS DURING APRIL, 1972,  
AND THE  
FIRST HALF OF MAY, 1972,  
AT  
NEW BRUNSWICK, NEW JERSEY

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New Brunswick, New Jersey

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## Introduction

This study was carried out at the request of King and Gavaris, Consulting Engineers, who wished to have detailed weather information during the periods when measurements were being made for the environmental impact survey being conducted in connection with the proposed Route 18 Extension in New Brunswick and Piscataway.

The elements which will be covered in this report include temperature, rainfall, humidity, cloudiness, wind speed and direction, and estimates of atmospheric ventilation.

This report will consider the following three time periods: (1) April 2 through April 30, 1972; (2) April 10 through April 23, 1972, the period when measurements were made at the Frelinghuysen Dormitory; and (3) May 1 through May 15, 1972, the period when measurements were made at the Music Building of Douglass College.

For each of these time periods, a comparison will be made between weather conditions in 1972 and the "expected" conditions based on long-term climatic "normals." In addition, a comparison between 1972 conditions and "extreme" conditions that have occurred in the past will be included.

### Temperature

April 2-30, 1972: (Table 1)

During the period April 2-30, temperature averaged about 3°F below the normal of 51°F. Daily high temperatures averaged 4°F below the normal of 62°F and the daily low temperatures averaged 2° below the normal of 40°F.

84°F was the highest temperature recorded at New Brunswick during this period, which was not very much below the record high temperature for April of 92°F which was recorded in 1941.

The lowest temperature recorded during the April 2-30 period was 23°F, which was well above the record low for April of 11°F recorded in 1923.

April normally has five days with minimum temperatures of 32°F or below. Of course, most of these frost days occur during the first half of the month since the average date of last spring frost is April 18. In 1972, there were six days with minimum temperatures of 32°F or below, the last of which was April 10, thus indicating the beginning of the frost-free period in 1972 eight days earlier than normal.

April 10-23, 1972: (Table 2)

Temperature during this period averaged only 1°F below the long-term average. The average high temperature

TABLE 1

TEMPERATURES (°F) DURING APRIL 2-30, 1972, AT  
NEW BRUNSWICK, NEW JERSEY, COMPARED WITH  
NORMAL AND EXTREMES FROM EARLIER YEARS

	1972	Normal
Mean Maximum	58	62
Mean Minimum	38	40
Mean	48	51
Maximum	84	92 (1941)
Minimum	23	11 (1923)
Days $\leq 32^{\circ}$	6	5

TABLE 2

TEMPERATURES (°F) DURING APRIL 10-23, 1972, AT  
NEW BRUNSWICK, NEW JERSEY, COMPARED WITH  
NORMAL AND EXTREMES FROM EARLIER YEARS

	1972	Normal
Mean Maximum	61	63
Mean Minimum	41	41
Mean	51	52
Maximum	84	92 (1941)
Minimum	29	22 (1950)
Days $\leq 32^{\circ}$	1	2

was 2°F below the normal of 63°F, while the average low temperature of 41°F was exactly normal.

The highest temperature recorded was 84°F, which was 8°F below the record high. The lowest temperature recorded was 29°F, which was only 7°F above the record low for this period.

Only one day with a temperature of 32°F or less occurred during April 10-23, 1972, compared with an expected two days.

May 1-15, 1972: (Table 3)

Average temperature during this period was very close to the normal of 59°F. However, the average daily high temperature of 69°F was 2°F below normal and the average daily low temperature of 49°F was 2°F above the normal. These temperature departures resulted from the unusually cloudy, rainy weather during the first half of May, 1972.

The highest temperature of 81°F was 13°F below the record high for this period and 3°F below the highest temperature recorded in April, 1972.

The lowest temperature of 38°F was well above the record low of 29°F, again reflecting the unusually heavy cloudiness of this wet period.

TABLE 3  
TEMPERATURES (°F) DURING MAY 1-15, 1972, AT  
NEW BRUNSWICK, NEW JERSEY, COMPARED WITH  
NORMAL AND EXTREMES FROM EARLIER YEARS

	1972	Normal
Mean Maximum	69	71
Mean Minimum	49	47
Mean	59	59
Maximum	81	94 (1930)
Minimum	38	29 (1907)
Days $\leq 32^{\circ}$	0	$\leq 1$

### Precipitation

April 2-30, 1972: (Table 4)

Total precipitation during this period was 3.05 inches which was 0.46 inches below the normal of 3.51 inches.

Perhaps of greater importance for the purposes of this study, however, is the fact that the number of days with precipitation of 0.01 inches or greater was 15 compared with the normal of 11. Thus, although the total rainfall accumulation during this period was slightly below average, the number of rainy days was above normal.

April 10-23, 1972: (Table 5)

Rainfall during this period was 2.12 inches compared with the normal of 1.64 inches. There were 9 days during this period with a measurable amount of precipitation of 0.01 inches or more compared with the normal of only 5 days. These data emphasize the fact that this period was considerably more cloudy and rainy than the New Brunswick normals would indicate.

May 1-15, 1972: (Table 6)

4.86 inches of rain fell during this period which was more than double the normal amount of 1.81 inches. The number of days with measurable rainfall was 10 which was nearly double the expected number of 6 days. This was an unusually wet period.

TABLE 4

RAINFALL (INCHES) DURING APRIL 2-30, 1972, AT NEW  
BRUNSWICK, NEW JERSEY, COMPARED WITH NORMAL

	1972	Normal
Rainfall Total	3.05	3.51
Days $\geq$ 0.01"	15	11

TABLE 5

RAINFALL (INCHES) DURING APRIL 10-23, 1972, AT NEW  
BRUNSWICK, NEW JERSEY, COMPARED WITH NORMAL

	1972	Normal
Rainfall Total	2.12	1.64
Days $\geq$ 0.01"	9	5

TABLE 6

RAINFALL (INCHES) DURING MAY 1-15, 1972, AT NEW  
BRUNSWICK, NEW JERSEY, COMPARED WITH NORMAL

	1972	Normal
Rainfall Total	4.86	1.81
Days $\geq$ 0.01"	10	6

### Humidity

April 2-30, 1972: (Table 7)

The mean maximum relative humidity during this period was 82%. The daily maximum relative humidity usually occurred during the early morning hours, before sunrise. There were 13 days during this period when the maximum relative humidity exceeded 90%.

The mean minimum relative humidity was 36%. The daily minimum usually occurred during the early afternoon at about the time of maximum temperature. The lowest humidity recorded at New Brunswick was 15% on April 21.

Normal maximum and minimum relative humidity data are not available for New Brunswick. However, normal relative humidity at Newark Airport at 1 A.M. in April is 64%. This figure should be close to the normal maximum. The normal relative humidity at Newark Airport at 1 P.M. in April is 46%. This should be close to the normal minimum.

Although rainfall during this period was slightly below normal, the high frequency of rainy days caused higher than normal relative humidities, especially during the morning hours.

April 10-23, 1972: (Table 7)

During this period in New Brunswick, the mean maximum relative humidity was 81%. There were 9 days

TABLE 7

RELATIVE HUMIDITIES (%) AT NEW BRUNSWICK, NEW  
 JERSEY, DURING THE PERIODS OF APRIL 2-30,  
 APRIL 10-23, AND MAY 1-15, 1972

	April 2-30	April 10-23	May 1-15
Mean Maximum	82	81	85
Mean Minimum	36	41	42
Minimum and Date	15 (21st)	15 (21st)	23 (12th)
Days $\geq$ 90%	13	9	8
1 A.M. Normal at Newark	64	64	70
1 P.M. Normal at Newark	46	46	51

with maximum relative humidity in excess of 90%.

The mean minimum relative humidity was 41%. The lowest relative humidity recorded was 15% on the 21st.

The April normals for Newark Airport of 64% at 1 A.M. and 46% at 1 P.M. should also be representative of the normal maximum and minimum during the April 10-23 period.

This period was also considerably more humid than normal, especially during the morning hours.

May 1-15, 1972: (Table 7)

The mean daily maximum relative humidity during this period was 85%. There were 8 days during this period with maximum relative humidities in excess of 90%.

The mean minimum relative humidity was 42%. The lowest relative humidity was 23% on May 12.

The normal 1 A.M. relative humidity at Newark Airport is 70% and the normal 1 P.M. relative humidity is 51%.

Since the May 1-15, 1972, period was unusually wet, it is not surprising that this was a period of above normal humidity, especially during the early morning hours.

#### Cloudiness

The nearest location to New Brunswick where regular cloud observations are made is Newark Airport. Since

a complete summary for each of the 24 hours will not be available for several weeks, teletype reports from Newark were used to compile the cloudiness data for the four daylight hours of 7 A.M., 10 A.M., 1 P.M., and 4 P.M., Eastern Standard Time. During the period covered by this study, frequent comparisons of sky cover between New Brunswick and Newark Airport were made. The results indicated that with very few exceptions the cloudiness at Newark Airport is quite representative of cloudiness at New Brunswick.

April, 1972: (Table 8)

With the exception of the 1 P.M. data, the number of clear days during April, 1972, was below normal. Thus, the combined total of cloudy and partly cloudy days is above normal for the hours of 7 A.M., 10 A.M., and 4 P.M. These results are consistent with the above normal number of rainy days, since it is quite possible for a rainy day to be partly cloudy as well as cloudy.

May 1-15, 1972: (Table 9)

The number of clear days during May 1-15 was less than normal at 7 A.M., 1 P.M., and 4 P.M. Thus, only at 10 A.M. was the combined total of cloudy and partly cloudy days equal to normal. At the other three hours, the combined total of cloudy and partly cloudy days was above normal which is consistent with the above normal number of rainy days.

TABLE 8

NUMBER OF CLEAR, PARTLY CLOUDY, AND CLOUDY DAYS DURING APRIL, 1972, COMPARED TO THE NORMAL CLOUDINESS DURING SELECTED DAYLIGHT HOURS AT NEWARK AIRPORT, NEW JERSEY

	1972				Normal			
	7A	10A	1P	4P	7A	10A	1P	4P
Clear <sup>1</sup>	9	7	8	6	10	9	8	8
Partly cloudy <sup>2</sup>	5	8	8	12	3	4	5	5
Cloudy <sup>3</sup>	16	15	14	12	17	17	17	17

<sup>1</sup>Clear = sky cover 30% or less.

<sup>2</sup>Partly cloudy = sky cover 40% to 70%.

<sup>3</sup>Cloudy = sky cover 80% to 100%.

TABLE 9

NUMBER OF CLEAR, PARTLY CLOUDY, AND CLOUDY DAYS DURING MAY 1-15, 1972, COMPARED TO THE NORMAL CLOUDINESS DURING SELECTED DAYLIGHT HOURS AT NEWARK AIRPORT, NEW JERSEY

	1972				Normal			
	7A	10A	1P	4P	7A	10A	1P	4P
Clear <sup>1</sup>	4	4	3	3	5	4	4	4
Partly cloudy <sup>2</sup>	1	4	5	4	2	3	3	3
Cloudy <sup>3</sup>	10	7	7	8	8	8	8	8

<sup>1</sup>Clear = sky cover 30% or less.

<sup>2</sup>Partly cloudy = sky cover 40% to 70%.

<sup>3</sup>Cloudy = sky cover 80% to 100%.

### Atmospheric Ventilation

Poor atmospheric ventilation is usually associated with periods of low wind speed (usually less than 8 mph), especially when low-level temperature inversions are present. These conditions are far more frequent at night, since clear skies at night almost always produce nocturnal radiation temperature inversions accompanied by light winds. Only when strong winds persist through the night will clear skies occur without the presence of a temperature inversion.

Most of the time, the nocturnal temperature inversion will be "burned off" by late morning of the following day. This is usually accompanied by improved atmospheric ventilation, visibility, and air quality during the mid-day and afternoon hours. However, occasionally a combination of meteorological factors may cause the temperature inversion and light winds to persist throughout the daylight hours. A stagnant or slow-moving high-pressure area on the weather map is most often responsible for persistent poor ventilation. Most serious air pollution episodes, during which atmospheric stagnation has persisted through several days and nights, have occurred under conditions of light winds and strong temperature inversions associated with stagnant high-pressure areas. Seventy-six percent of these periods occur during the months of September through December.

On the other hand, when good ventilation associated with strong winds occurs in the early morning hours, it usually persists throughout the day.

During the time periods of interest in this study, a number of dates could be identified, on the basis of wind speed, visibility, and cloudiness, as dates when poor ventilation occurred during the night and early morning hours followed by improved ventilation later in the day (Table 10).

On a few dates, poor ventilation persisted throughout the day and into the following night. However, there were no two consecutive such dates, and no stagnant high-pressure areas over New Jersey during April, 1972, or May 1-15, 1972.

There were many days when good ventilation and relatively strong, gusty winds persisted throughout the day. These dates represent periods when general air pollution levels would be expected to be low. Dates not included in Table 10 were dates which could not be clearly identified as having either poor or good ventilation. Further information on atmospheric stability would be required in order to determine the atmospheric ventilation on these dates.

TABLE 10

DATES OF POOR AND GOOD ATMOSPHERIC VENTILATION AT  
NEW BRUNSWICK, NEW JERSEY, DURING APRIL, 1972,  
AND MAY 1-15, 1972

	April	May
Poor all day	4*, 6, 13*	3*
Poor in A.M.	10, 11*, 12, 19, 20*, 23*, 28, 29, 30*	1, 4*, 6, 14*, 15
Good all day	3, 5, 7*, 8*, 9, 14, 17, 18, 21, 25, 26, 27	5*, 9*, 12, 13

\*Day with precipitation.

### Wind Speed and Direction

Normals of wind speed and wind direction are not available for New Brunswick. However, ten years of hourly wind observations for Newark Airport have been summarized and are quite representative of wind in the New Brunswick area.

For New Brunswick, during April and May, 1972, only one wind observation each day is available due to the wind recorder being inoperative. This observation was made at 8 A.M. EST during April and 7 A.M. EST during May. These observations were compared with wind speed and direction at Newark Airport for 7 A.M. EST.

Normally, during April, the most frequent wind direction is West Northwest which occurs with a frequency of 9%. South Southwest, Southwest, and West Southwest all occur with a frequency of 8%. Average wind speed from the Northwest is stronger, 14 mph, compared with only 10 mph from the Southwest. Wind speeds of less than 8 mph occur with a frequency of 4% from the Southwest, compared with only 1% from the Northwest.

During May, normally the most frequent wind direction is from the Southwest which occurs 10% of the time. Northwest winds occur only 7% of the time in May. However, as in April, Northwest winds are stronger, averaging 13 mph compared with only 9 mph from the Southwest. Wind speeds of less than 8 mph occur with a frequency of 5%

from the Southwest compared with only 1% from the Northwest.

April 2-30, 1972: (Table 11)

During this period, the wind direction at New Brunswick at 8 A.M. EST was from the Northwest and West on 5 days, from the North on 4 days, from the Southwest on 3 days, and Calm on two days. Seven other directions were recorded on one or two days. At Newark Airport at 7 A.M. EST, wind direction was from the Northwest and Southwest on 5 days, from the North on 4 days, from the Southeast on 3 days, and Calm on two days. Eight other directions were reported on one or two days.

Average wind speed at New Brunswick at 8 A.M. EST during this period was 5 mph. The maximum was 12 mph from the Northwest. The mornings of April 16th and 20th reported Calms at 8 A.M. At Newark Airport the 7 A.M. EST wind speed averaged 7 mph. The maximum was 16 mph from the North. Calms were reported on the mornings of April 16th and 28th.

April 10-23, 1972: (Table 11)

During this period, the wind direction at New Brunswick at 8 A.M. EST was from the Northwest, West, and Southwest on two days each, 2 days were Calm and 9 other directions occurred on one day each. At Newark Airport, at 7 A.M. EST, Southwest winds occurred on 3 days, winds

TABLE 11

COMPARISON OF EARLY MORNING WIND SPEEDS AT  
NEW BRUNSWICK AND NEWARK AIRPORT DURING  
APRIL, 1972, AND MAY 1-15, 1972

	April 2-30 (8 A.M. EST)	April 10-23 (8 A.M. EST)	May 1-15 (7 A.M. EST)
<u>New Brunswick</u>			
Mean	5 mph	4 mph	7 mph
Maximum	12 mph (NW)	10 mph (NW)	18 mph (NE)
Minimum	Calm (16th and 20th)	Calm (16th and 20th)	Calm (6th and 13th)
<u>Newark (7 A.M. EST)</u>			
Mean	7 mph	6 mph	6 mph
Maximum	16 mph (N)	12 mph (E)	18 mph (NE)
Minimum	Calm (16th and 28th)	Calm (16th)	Calm (6th and 13th)

from Northwest and Southeast were reported twice, there was one Calm, and 6 other directions occurred on one day each.

Wind speed at New Brunswick at 8 A.M. EST averaged 4 mph with a maximum of 10 mph from the Northwest. The mornings of April 16 and 20 were Calm at this time. Newark Airport at 7 A.M. had an average wind speed of 6 mph with a maximum of 12 mph from the East. April 16 was also Calm at Newark.

May 1-15, 1972: (Table 11)

During this period, the wind direction at New Brunswick at 7 A.M. EST was from the West and Southwest on two days each, there were two Calms, and 9 other directions occurred on one day each. At Newark Airport at 7 A.M. EST, the wind direction was from the Southwest on 4 days, from the Northeast and Southeast on two days each and there were two Calms. Five other directions were reported on one day each.

Wind speed at New Brunswick at 7 A.M. EST averaged 7 mph. The maximum was 18 mph from the Northeast. Calms were recorded on May 6 and 13. At Newark Airport at 7 A.M. EST, the average wind speed was 6 mph. The maximum was 18 mph from the Northeast. Calms were recorded on May 6 and 13.

A detailed summary of wind and cloudiness at

Newark Airport, based upon eight observations daily, will be available from the National Climatic Center in about one month. When available, these data will permit a more detailed comparison of April, 1972, and May 1-15, 1972, with the normal wind and cloudiness to be expected during these periods.

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