DIGITAL LEVEL SLICING OF IR IMAGERY FOR THERMAL PLUME STUDIES

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ABSTRACT

Thermal infrared line scanner imagery of the Pickering Nuclear Generating Station was obtained from an overflight on September 10, 1973. The imagery was analysed by electronic digital level slicing techniques. An example of the data is shown and discussed in relation to its application in thermal plume analysis.

INTRODUCTION

One of the sensor packages available to users, from the Canada Centre for Remote Sensing, is a Daedalus Thermal infrared line scanner. The output of this system provides a magnetic tape which may be digitally processed to provide a series of grey levels representing a specified range of temperatures. This type of system is ideally suited for application to thermal plume studies where synoptic imagery of the surface thermal structure can be an important input.

In order to gain experience in using this type of system the Remote Sensing Section at CCIW requested a series of overflights along the north shore of Lake Ontario in the Oshawa-Oakville area. Out of a total of four flights only one set of imagery was found to be suitable for digital slicing. This was unfortunately was due to instrumentation problems on the first three flights. During the successful mission imagery of the Pickering Nuclear Plant was obtained and is discussed in this report.

THE IMAGERY

Figure 1 shows a photograph of the Pickering area taken during the overflight. The photographic imagery is shown for reference purposes. It should be noted, however, that no visible evidence of the plume is apparent. The digitally sliced thermal infrared imagery is shown in Figure 2. The grey scale goes from black to white in a series of eight levels. The temperatures corresponding to each level are indicated on the dotted contour lines. Due to the setting of the upper scale reference during the flight the grey scale (white end) is "washed out" and temperatures greater than 15°C are not resolved. Points a, b, c and d on Figure 2 are sub-surface temperature monitoring stations operated by Ontario Hydro (J.B. Bryce, private communication). These "ground truth" reference points indicate that the absolute range of temperatures on the imagery is not inconsistent with actual on site values (see Table 1).

The imagery shows clearly the surface characteristics of the plume and its westward progression along the shore under the influence of light (0 - 2 mps) west south west winds. Also clearly indicated is the extent of the plume out into the lake in this case the 10°C isotherm extends approximately 1-1.5 km from the shore.

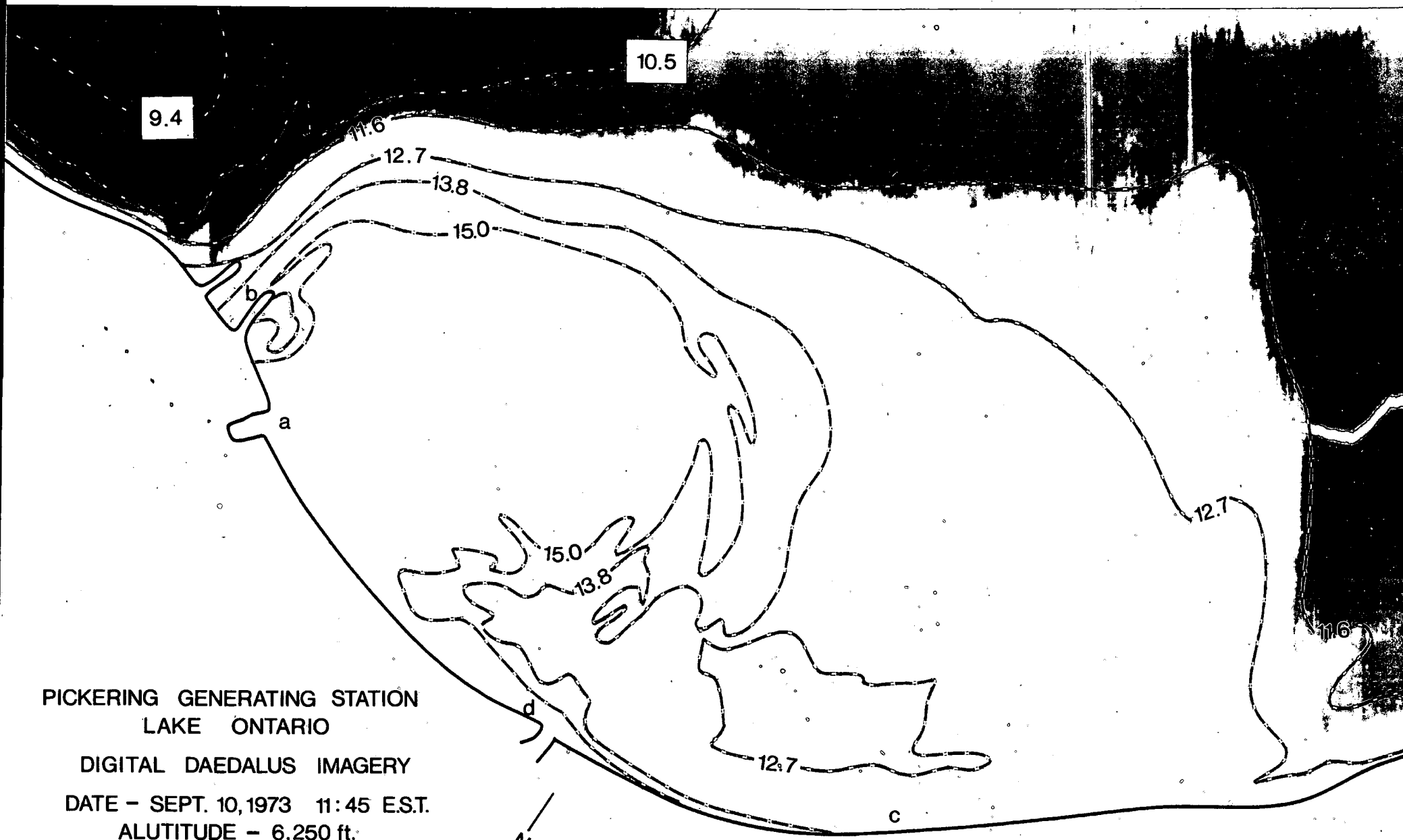
A two dimensional section of the plume is shown in Figure 3. This was done by using the sub-surface reference temperatures in conjunction with the imagery. This example indicates the sub-surface configuration of the plume and its westward orientation.

CONCLUSIONS

The imagery described in the text illustrates clearly the value of digitally sliced data for rapid assessment of surface thermal structure. This type of remote sensing data can provide a detailed "climatology" of thermal plumes under a variety of local meteorological conditions and can be used in both model development and verification studies.

FIGURE 1

Aerial Photograph of Pickering Nuclear Power Station
(Altitude 6,250 ft)



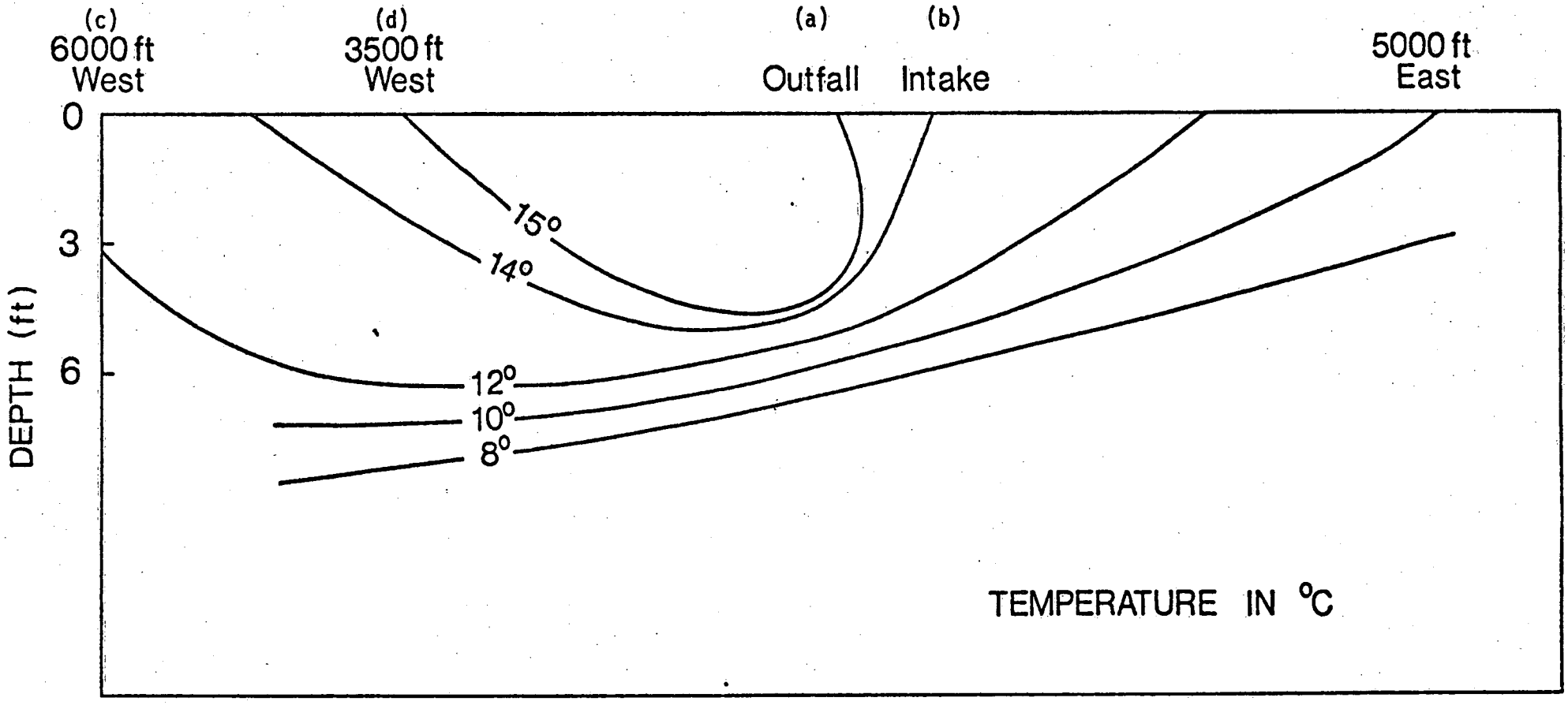
PICKERING GENERATING STATION
LAKE ONTARIO

DIGITAL DAEDALUS IMAGERY

DATE – SEPT. 10, 1973 11:45 E.S.T.
ALUTITUDE – 6,250 ft.
TEMPERATURE CONTOURS °C

0 500
METRES

FIGURE 2



TEMPERATURE PROFILE ALONG SHORE AT PICKERING, SEPTEMBER 10, 1973

FIGURE 3.

TABLE I

Temperatures Measured at Reference Points

Depth	6000 ft west (c)	3500 ft west (d)	Outfall (a)	Intake (b)	5000 ft east
3 feet			19.5°C		
6 feet	11.0°C	12.5°C		8.0°C	7.0°C