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The vegetation of Clara Bog in relation to the hydrology and waterchemistry

M. Neefjes, 1989

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ABSTRACT

In raised bogs the presence of different vegetation types is probably determined by the surface flow and related to the waterchemistry.

Hummock-hollow and other wet vegetation types are situated in flat areas where the waterflow is impeded by the small difference in hydraulic potential, caused by the small slope.

Most chemicals show a decline in concentration from the dry edge to the wet soak vegetation. This could be explained by the fact that decomposition is higher in dryer environments.

The low concentrations in the soak area are remarkable because of the apparently more nutrient-requiring vegetation. Perhaps the nutrients are only released in the spring and taken up by the plants immediately.

SAMENVATTING

In hoogvenen wordt de aanwezigheid van verschillende vegetatie-types waarschijnlijk bepaald door oppervlakte-stroming en heeft te maken met de chemische samenstelling van het water.

Bult-slenk complexen en andere natte vegetatie-types bevinden zich in vlakke delen waar de waterstroming vertraagd wordt door het kleine hydropotentiaalverschil, veroorzaakt door het kleine hoogteverschil.

De meeste chemische stoffen in het water vertonen een afname van de droge rand naar de natte soakvegetatie. Dit zou verklaard kunnen worden door het feit dat de decompositie hoger is in droge omgeving.

De lage concentraties in het soak-gebied vallen op vanwege de schijnbaar meer nutriënten eisende vegetatie. Wellicht komen de nutriënten alleen vrij in het voorjaar en worden dan onmiddellijk weer door de planten opgenomen.

INTRODUCTION

In all ecosystems the vegetation is not only determined by the type of substrate and the available nutrients, but also by the behaviour of water, the hydrology. This is not different in a raised bog. In bogs water plays a major role because a bog can only thrive when it is waterlogged. This stage is maintained by high rainfall and a low hydraulic conductivity (Ingram, 1987A).

Because on a yearly basis evaporation is less than rainfall (Streefkerk and Caspari, 1987) and not all the remaining water is stored in the bog, some water must be lost from the system in other ways: there must be an efflux.

Waterflux is described as a result of hydraulic potential. The water flows from a high to a low potential. However, a large difference in potential does not automatically mean a high flow rate, because a difference in potential can be maintained when there is either a high resistance or a large slope. Only in the last case it means a high flow rate (Streefkerk, personal communication, 1989).

According to Streefkerk and Caspari (1987) surface flow is the main component of efflux. This can be explained by the fact that the hydraulic conductivity of the acrotelm is very high compared with the catotelm. Because of the large difference in this conductivity the flow through the acrotelm, the surface flow, is considered to be distinct from the bog itself (Ingram, 1983). Therefore it seems likely that the occurence of the various vegetation types is determined by the varieties in the rate and chemical composition of the surface flow.
Different aspects of waterflux in bogs have been studied but its relation to the vegetation on top of the bog still requires further investigation.
The purpose of this study was to try to explain the position of vegetation types by examining the hydrology of the bog and the chemistry of the surface water.

STUDY SITE

Clara Bog is a raised bog in County Offaly in the Midlands of Ireland. Especially the western part of it is relatively undisturbed and has several well-developed hummock-hollow systems. A special feature, and therefore an important reason that the bog is now a nature reserve, is the soak-system: a system of lakes accompanied by a special vegetation that is dominated by plants that usually occur in fen situations where more nutrients are available than in a rain-fed raised bog. The soak is thought by some to be a kind of spring where rich water wells up from the mineral underground; others consider it to be a sink where water (with its nutrients) is collected from a large part of the bog.
The eastern side of the bog is drained to a large extent; therefore this study was carried out on the western part. Of this part a certain area was chosen that was expected to be a hydrological unit, on grounds of a contour map of Bord na Mona (Irish Turf Board) (1982-83).
The field work of this project took place in October and November of the year 1988.

METHODS

vegetation

The vegetation survey was performed by making 59 vegetation

relevés of 2 meters square. Each relevé contained percentages cover of vascular plants, mosses, the larger liverworts and lichens.
A classification was made of the resulting vegetationdata using the computerprogram TWINSPAN (Hill, 1979). The result of this classification was listed in a vegetation table.
A general vegetation-map of this area was made, based upon the vegetation-types that could be distinguished in the field.
The nomenclature follows Heukels and van der Meijden (1983) for vascular plants, Smith (1980) for bryophytes, Watson (1981) for liverworts and Wirth (1987) for lichens.

hydrology

The hydrology was studied in 21 stations scattered over the western half of Clara Bog, including a transect of about 750 meters which went through the largest hummock-hollow complex. One station was situated in the soak area.
Each station consisted of at least three PVC-tubes. One was a dipwell, a tube 50 cm long with slits over the whole length. The lower end was shut to prevent peat from entering while inserting the tube. A dipwell is used to measure the depth of the watertable.
The other two tubes were piezometers: tubes, also shut, with slits only at the lower end and covered with a piece of nylon stocking to make sure only water would enter. Piezometers are used to measure hydraulic pressure at a particular depth (Ingram, 1987B), in this case 1 and 3 meters. At some stations a piezometer of 5 meters was present as well.
All tubes were covered with a cap protecting it from rain. The caps were loose fitted to prevent a build up of pressure.
The altitude of all the stations (in m. above Irish Sea Level) was measured with the aid of a level. After establishing these altitudes a convenient local datum surface lying within the bog could be chosen, in this case 54 m. above Irish Sea Level. The results of the altitude measurements were used to make a contour map. With the aid of the local datum surface it was possible to calculate hydraulic potential (Ingram, 1987B).
The results of the dipwell and piezometer measurements were drawn in a cross-section of the transect and a map of the total area. In these figures isopotentials (lines of equal potential) were drawn. Water flows normal to these isopotentials.
The watertable and hydraulic pressure were measured once a week, seven weeks in a row. This was achieved by inserting into the tube a flexible hose with the lower end straightened

with a bamboo rod. Measurements were then taken by blowing through the tube and when the waterlevel was reached bubbles could be heard. The accuracy of this method lies within 0.5 cm.

chemistry

To get extra information about the differences between vegetation-types watersamples were taken at the dipwells at all the stations. The samples were filtered and in the field the pH was measured with a glass electrode.. A few drops of CCl_4 were added to fixate the samples and they were analysed within five days in the laboratory in Amsterdam. Conductivity was measured with a Philips PW 9505 conductivitymeter. Phosphor and nitrogen were measured colorimetrically with a Technicon II auto-analyzer, PO_4 as a molybdate-complex, NO_2 and NO_3 as an azo-complex at 550 nm, and NH_4 at 660 nm. Calcium, potassium, iron, manganese and aluminium were measured spectrophotometrically with a Perkin Elmer 1100B atomary absorption spectrophotometer.

The stations were divided into five vegetation areas: edge, dry, wet, hummock-hollow and soak vegetation. Per chemical the average was taken of all the stations of one area, and plotted in a bar diagram.

RESULTS

vegetation

The classification of the vegetation data has resulted in a vegetation table (table 1). On grounds of this vegetation table several divisions can be made in the relevés. The first division can be made into bog and soak vegetation. In the soak vegetation the *Myrica gale*-thickets that occur at several places on the bog are also included.

The bog vegetation can easily be divided into dry and wet on grounds of the presence of *Scirpus cespitosus* on one hand and high abundancy of *Sphagnum cuspidatum* on the other. The wet section can in turn be divided again into wet areas with hardly any open water and areas with a considerable surface of open water defined by a very high abundancy of *Sphagnum cuspidatum* and representing hummock-hollow vegetation.

In the soak area one can see several vegetation types that are dominated by one very conspicuous species. The remaining soak relevés can be described as "transitional" soak vegetation.

vegetation in dry areas

In the dry type *Scirpus cespitosus* is the most important species. In the moss layer several species of the genus *Campylopus* occur: *C. introflexus, C. fragilis* and *C. pyriformis* . *Erica tetralix* and *Nartecium ossifrage* are present in relatively high abundancies.

vegetation in wet areas
In this type the abundancy of *Sphagnum tenellum* is comparatively high. In small wet depressions *S. cuspidatum* is present, but only in low abundancies.

hummock-hollow vegetation
This vegetation type is dominated by *Sphagnum cuspidatum* and several other *Sphagnum* species as *S. capillifolium* and *S. magellanicum*, representing respectively hollow, hummock and lawn.

transitional soak vegetation
As its name implies, this vegetation type has aspects of both the bog and the soak vegetation. It does have its own aspects though. It is the only vegetation type where *Pleurozium schreberi* and *Sphagnum subnitens* occur in the moss layer in relatively high abundancies.

***Eriophorum vaginatum* dominated vegetation**
Between the *Eriophorum vaginatum* which dominates the appearance, *Oxycoccus palustris, Sphagnum capillifolium* and *Aulacomnium palustre* are found.

***Myrica gale* dominated vegetation**
The only discriminating, but very dominant, species in this vegetation type is *Myrica gale* itself. It usually occurs in thickets near the pond or scattered on the bog.

***Betula pubescens* dominated vegetation**
This vegetation type has a forest-like appearance due to the *Betula pubescens*. In the moss layer *Sphagnum palustre* is present. *Dryopteris carthusiana* occurs, and *Molinia caerulea* , though in low abundancies. *Pteridium aquilinum, Eurhynchium praelongum, Vaccinium myrtillus* and *Sphagnum recurvum var. mucronatum* can be found in this vegetation type.

***Molinia caerulea* dominated vegetation**
Between the *Molinia caerulea* some *Myrica gale* occurs and often *Sphagnum cuspidatum* and *S. palustre* are present.

On the vegetation map (fig. 1) these types are indicated. The condensed table (table 2) gives the information in a more bite-size form.

hydrology

The results of the hydrological measurements were processed by using the average per station. For fifteen stations this was the average of seven weeks; for six stations in the transect only of five weeks, because the tubes of these stations were put in later and took some time to fill up.

In fig. 2 the hydraulic potentials of the stations in the transect are drawn. The results of the dipwells were taken as the hydraulic potential at the watersurface (and thus at atmospheric).

The results of all the stations are illustrated in fig. 3-6. Fig. 3 is a contour map, fig. 4, 5 and 6 are maps of hydraulic potential, at the water table, 1 m. and 3 m. depth respectively. Contours and isopotentials were drawn with help of these results and field observations.

chemistry

The results of the chemical analyses are shown in fig. 7.

CONCLUSIONS

As said, differences in potential are the result of both resistance and slope. Since it is known that the resistance is low in the acrotelm, difference in potential will very directly influence the flow rate. In fig. 2 one phenomenon draws the attention. In the flatter parts the potential does not change as rapidly as in steeper parts, which results in a lower flow rate in these flatter parts. From field observations is known that the areas around station 17, and station 19 & 13, are wet, the latter even a hummock-hollow complex. Putting the vegetation map and the water table map together (fig 1 and 4) also shows that wetter areas are situated in flatter parts of the bog.

It is likely that hummock-hollow complexes always occur in such flat areas where waterflow is impeded. This matches well with the experience that these complexes usually occur in the middle of a raised bog rather than at the steeper edges (V.d. Molen, personal communication, 1989).

In the diagrams in fig. 7 some aspects draw the attention. Firstly, most metals and some nutrients show a clear trend from high values in dry and low values in wet environment.

As explained earlier, dry vegetation types are determined by slope rather than level, so the high values can not be explained

by the high or low position of these areas on the bog. A possible explanation is that in dry situations the decomposition is higher. A dry environment means that the watertable lies relatively deep and therefore oxygen can penetrate deeper compared with a wet situation.
Another explanation could be that in wet situations the watersample is taken mainly from the acrotelm where water flows fast and is diluted by rainwater.
For the dry edges there is an extra argument. The water flows in the direction of the edge (fig. 4) and thus nutrients are collected there.
The most remarkable aspect of these diagrams however is that the soak water has in most cases a very low value, where the nutrient-requiring vegetation would suggest otherwise.
It is clear that the plants will have to get their nutrients in another way, either from another source, or at another time.
One can imagine that in spring when the weather grows warmer the rate of decomposition increases. But since this is also the beginning of the growth-season, the rate of uptake of the nutrients will be high as well. So perhaps the time between decomposition and uptake is so short that the nutrients cannot be measured in the water.
All these hypotheses leave the two anomalies, aluminium and ammonium unexplained.
It must be stated that the samples were not taken during the growth season, during which they could give altogether different results.

RECOMMENDATIONS

When back from a field trip, one always comes up with a lot of things that should have been investigated also. In this case suggestions for further research would be in the first place to make a very dense grid of levelings, to get a detailed idea of the contours of the bog. The watersamples could be taken at regular intervals during the whole year and in many places, especially in the various soak vegetation types. For comparison it would be good to sample rainwater as well. To investigate the soak theories, samples could be taken at various depths and also of the water that comes from the esker which forms the mineral underground.

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Table 1 **VEGETATION TABLE**

vegetatietabel Clara Bog 1988

BOG – DRY

nr. species	27	40	5	57	15	9	41	51	19	44	43	32	7	14	1	26	11	30	54	35	18	8	10	39	45	31	4
1 Campylopus introflexus	13	1	1	1	3	1						1	1									1			3	5	
2 Campylopus fragilis	20	1	1				2							1		3											
3 Carex panicea		15	1	3	27	3	20	25	50	8											1			7			6
4 Scirpus cespitosus		25	20	18	16	10	10	10	5	5	30	30	15	10	10	7	5	5	5	3	3	1				4	
5 Cladonia furcata		1		2				1		1	1	1						1			1	1					1
6 Campylopus pyriformis					1				1			1	1					3			1						
7 Rhynchospora alba				1	2			1			3	1	5				1	1									
8 Cladonia uncialis										1	1			1	1					1			1	1			2
9 Drosera rotundifolia		1	1		1		1						1	1	1							1		1			
10 Odontoschisma sphagni		1	1	7	1		2			1	2	3	3		2	1	1	5	1	1	1	1	1		2	1	
11 Polytrichum juniperinum			1				5																				
12 Narthecium ossifrage			6	7	27	16	10	10	2	1	8	8	5	3	1		5	15	1	3		3	3	1	5	5	7
13 Cladonia portentosa	1	1	1	3	1	1	1	6		63	1	1	1	3	9	1	2	2	15	19	1	2	39	24			18
14 Sphagnum tenellum			7	30	10	3	10	6	15	11		5	10		15		11	10	8	20	15	15	15	5		1	15
15 Eriophorum angustifolium		10	12	5	4	15	5	14	3	2	5	2	5	2	1		5	6	5	18	6	1	1	3	2	3	8
16 Erica tetralix		8	10	5	5	10	5	6	10	5	8	10	10	10	3	25	5	25	6	5	5	20	4	2	8	7	10
17 Sphagnum subnitens				4		1		2		7	6																
18 Andromeda polifolia							1		1	1	1	1	1		1		1	1		1	1			1	1	1	
19 Calluna vulgaris	80	7	30	35	15	15	6	9	15	36	12	15	20	65	40	45	35	15	60	35	25	55	36	38	12	18	40
20 Eriophorum vaginatum	3	30	10	7		16	15		10	6	14	20	20	10	30	8	10	30	15	6	55	3	6	20	18	17	8
21 Sphagnum capillifolium		17	6	8	9	15	18	8	8	7	18	29	5	3	26		14	7	25	15	10	9	6	8		25	13
22 Sphagnum magellanicum			6		1		18	8	10				10		2		11	5	10	26	20	1	1	3	45	10	
23 Sphagnum papillosum		3	7		3	6	10		3	6	15	30	1	1	15		11	10	13	10	10	2	1	3	10	20	5
24 Hypnum cupressiforme	2	8	1	10	2	1	5	6	3	2	10	1	2	7	30	21	11	10	13	8	20	3	2	6		2	35
25 Sphagnum cuspidatum					1	1	2	5	1			5	2		2				5	2	5					1	2
26 Polytrichum formosum												1															
27 Oxycoccus palustris															1						1						
28 Aulacomnium palustre								3							1												
29 Sphagnum recurvum var. mucr																											
30 Myrica gale																											
31 Betula pubescens																											
32 Pleurozium schreberi																											
33 Empetrum nigrum																											
34 Pteridium aquilinum																											
35 Eurhynchium praelongum																											
36 Vaccinium myrtillus																											
37 Juncus effusus																											
38 Dryopteris carthusiana																											
39 Sphagnum palustre																											
40 Molinia caerulea																											
41 Cladonia minispec.	1																										
42 Cladonia fimbriata																1											
43 Racomitrium lanuginosum				1																							
44 Sphagnum fuscum			2																							1	
45 Leucobryum glaucum																	1										
46 Sphagnum imbricatum							2																				
47 Lycopodium selago								1																			
48 Dicranum scoparium																						4					
49 Cladonia spec.																									25		
50 Drosera anglica																											
51 Galium saxatile																											
52 Luzula multiflora																											
53 Potentilla erecta																											
54 Pohlia nutans																											
55 Rubus fruticosus																											
56 Climacium dendroides																											
57 Phragmites australis																											

BOG – WET

nr. species	NO OPEN WATER 1	19	55	6	38	OPEN WATER (HU-HO) 2	52	20	42	48	47
1 Campylopus introflexus											
2 Campylopus fragilis											
3 Carex panicea											
4 Scirpus cespitosus											
5 Cladonia furcata				1							
6 Campylopus pyriformis							2				
7 Rhynchospora alba					1	2	2				
8 Cladonia uncialis	2	1		2							
9 Drosera rotundifolia	1		1	1		1				1	
10 Odontoschisma sphagni	1	2	15	2		1	1	10			
11 Polytrichum juniperinum											
12 Narthecium ossifrage	1	1	8	1	3		3		2	7	
13 Cladonia portentosa	8	4		18		5		6	2		
14 Sphagnum tenellum	20	15	3	28	15	8	3	10	8		
15 Eriophorum angustifolium	1	2	25	1	10	4	4	12	8	7	5
16 Erica tetralix	5	2	10	6	4	6	3	2	10	5	4
17 Sphagnum subnitens											
18 Andromeda polifolia	1	1	1	1	1	1	1	1	1	1	1
19 Calluna vulgaris	70	33	18	46	1	45	37	43	30		8
20 Eriophorum vaginatum	6	10	5	8	2	4	4	7	10	8	15
21 Sphagnum capillifolium	20	7	5	60		15	10		10	18	15
22 Sphagnum magellanicum	15	50	60	2	80		15	12	46	4	30
23 Sphagnum papillosum	25	7	10	6	15			6		9	5
24 Hypnum cupressiforme	5	15	6	5		28	12	3	10	1	
25 Sphagnum cuspidatum	2	3	2	6	10	50	50	50	26	65	40
26 Polytrichum formosum											
27 Oxycoccus palustris		1	1				1		1	2	1
28 Aulacomnium palustre							2		1	7	10
29 Sphagnum recurvum var. mucr											
30 Myrica gale											
31 Betula pubescens											
32 Pleurozium schreberi									1		
33 Empetrum nigrum											
34 Pteridium aquilinum											
35 Eurhynchium praelongum											
36 Vaccinium myrtillus											
37 Juncus effusus											
38 Dryopteris carthusiana											
39 Sphagnum palustre											
40 Molinia caerulea											3
41 Cladonia minispec.											
42 Cladonia fimbriata											
43 Racomitrium lanuginosum											
44 Sphagnum fuscum											
45 Leucobryum glaucum											
46 Sphagnum imbricatum											
47 Lycopodium selago											
48 Dicranum scoparium											
49 Cladonia spec.											
50 Drosera anglica											1
51 Galium saxatile											
52 Luzula multiflora											
53 Potentilla erecta											
54 Pohlia nutans											
55 Rubus fruticosus											
56 Climacium dendroides											
57 Phragmites australis											

SOAK

nr. species	TRANSIT. SOAK 22	36	50	ERIOPH. VAGI. 37	34	59	MYRICA GALE 46	17	23	56	12	BETULA PUBESCENS 33	24	21	53	49	MOLINIA CAERULEA 25	16	28	13
1 Campylopus introflexus								2							1			1		
2 Campylopus fragilis																				
3 Carex panicea																				
4 Scirpus cespitosus				4							1									
5 Cladonia furcata																				
6 Campylopus pyriformis																				
7 Rhynchospora alba																				
8 Cladonia uncialis																				
9 Drosera rotundifolia		1																		
10 Odontoschisma sphagni	1			1																
11 Polytrichum juniperinum					5															
12 Narthecium ossifrage	8	1							2											
13 Cladonia portentosa			10				2		1							1				
14 Sphagnum tenellum					1			3	10		2						3			
15 Eriophorum angustifolium	4	1	4	3			80	2		6										
16 Erica tetralix	6			2	1	3	2	10	5	2	1	1						1		
17 Sphagnum subnitens	2	55																		
18 Andromeda polifolia	1	1		1	2	1	1	1	1	1	1								1	
19 Calluna vulgaris	10	10	80	13	14	7	8	80	18	58	4	4	25	10	3					1
20 Eriophorum vaginatum	16	2	15	70	66	84	2	8	13	2		15	7	3	20			1		
21 Sphagnum capillifolium		7	12	55	15	20	15	3	40	7	4	2	6						1	
22 Sphagnum magellanicum	40	10	2	7	2	20	35	2	6	6	15				5					2
23 Sphagnum papillosum	13	1		8	13	30	6	15	35	8			15	15			3			
24 Hypnum cupressiforme			4		2			60	3		2		2	16	13	1				1
25 Sphagnum cuspidatum	35	8					5				2		3	30	50		1		20	2
26 Polytrichum formosum	1	6		2						8		20			1			1		
27 Oxycoccus palustris	2	1	1	5	2	6	1		1	2	1	2	1	1				1	1	
28 Aulacomnium palustre	8	10	2	28	8	10	30	1	2	6	3		40	1	1	2			10	
29 Sphagnum recurvum var. mucr	1	2			8		5	7	6	13			2	6		45	3	2		
30 Myrica gale							1	30	50	78	100		2	10	5	5	2	3	10	10
31 Betula pubescens				1	1					2		6	35	80	100	60				
32 Pleurozium schreberi	2	3	55							5		73								
33 Empetrum nigrum												40		1				1		
34 Pteridium aquilinum												5	8							
35 Eurhynchium praelongum													1	1		15				
36 Vaccinium myrtillus														1	1	20				
37 Juncus effusus														7	12		8			
38 Dryopteris carthusiana										1		2	1	1	1	3	2	1	1	
39 Sphagnum palustre													3	8	20	28	6	8	50	
40 Molinia caerulea		1	10								94	16	2	2	2	23	100	100	80	100
41 Cladonia minispec.																				
42 Cladonia fimbriata																				
43 Racomitrium lanuginosum																				
44 Sphagnum fuscum																				
45 Leucobryum glaucum																				
46 Sphagnum imbricatum																				
47 Lycopodium selago																				
48 Dicranum scoparium															1					
49 Cladonia spec.																				
50 Drosera anglica																				
51 Galium saxatile																	1			
52 Luzula multiflora																			1	
53 Potentilla erecta											1			1						
54 Pohlia nutans																			1	
55 Rubus fruticosus																2				
56 Climacium dendroides													4							
57 Phragmites australis																				

NO OPEN WATER | OPEN WATER (HU-HO) | TRANSIT. SOAK | ERIOPH. VAGI. | MYRICA GALE | BETULA PUBESCENS | MOLINIA CAERULEA

DRY | WET

BOG | SOAK

In this table the species that occur only once are listed at the bottom of the table.

Table 2

CONDENSED VEGETATION TABLE

nr	species	dry	wet	hu-ho	transit. soak	Erio. vagi	Myrica	Betula	Molinia
1	number of releves	27	5	6	3	3	5	5	4
2	Campylopus introflexus	III 1.2 1-13					I 0.4 2	I 0.2 1	I 0.3 1
3	Campylopus fragilis	II 1.2 1-20							
4	Carex panicea	III 6.2 1-50							
5	Scirpus cespitosus	V 9.1 1-30				II 1.3 4	I 0.2 1		
6	Cladonia furcata	II 0.4 1-2	I 0.2 1						
7	Campylopus pyriformis	II 0.3 1-3		I 0.3 2					
8	Rhynchospora alba	II 0.6 1-5	I 0.2 1	II 0.7 2-2					
9	Cladonia uncialis	II 0.3 1-2	III 1.0 1-2						
10	Drosera rotundifolia	II 0.3 1-1	III 0.6 1-1	II 0.3 1-1	II 0.3 1				
11	Odonthoschisma sphagni	IV 1.4 1-7	IV 4.0 1-15	III 2.0 1-10	II 0.3 1	II 0.3 1			
12	Polytrichum juniperinum	I 0.2 1-5				II 1.7 5			
13	Narthecium ossifrage	V 5.7 1-27	V 2.6 1-8	III 2.0 2-7	IV 3.0 1-8		I 0.4 2		
14	Cladonia portentosa	V 7.6 1-53	III 6.0 4-18	III 2.0 2-5	II 3.3 10		II 0.6 1-2	I 0.2 1	
15	Sphagnum tenellum	IV 8.8 1-30	V 15.8 3-26	IV 4.0 3-10		II 0.3 1	III 3.0 2-10		II 0.6 3
16	Eriophorum angustifolium	V 5.2 1-18	V 7.8 1-25	V 6.3 4-12	V 3.0 1-4	II 1.0 3	III 19.4 2-90		
17	Erica tetralix	V 8.4 2-25	V 5.2 2-10	V 4.8 2-10	II 1.7 5	V 2.0 1-3	V 4.0 1-10	I 0.2 1	II 0.3 1
18	Sphagnum subnitens	I 0.7 1-7			IV 19.0 2-55				
19	Andromeda polifolia	III 0.5 1-1	V 1.0 1-1	V 1.0 1-1	IV 0.7 1-1	V 1.3 1-2	V 1.0 1-1		II 0.3 1
20	Calluna vulgaris	V 24.7 5-80	V 32.8 1-70	V 26.8 6-45	V 23.3 10-50	V 11.3 7-14	V 28.6 4-60	IV 8.4 3-25	II 0.3 1
21	Eriophorum vaginatum	V 14.2 3-55	V 6.2 2-10	V 8.0 4-15	V 10.7 2-15	V 80.0 70-86	IV 4.6 2-13	IV 9.0 3-20	II 0.3 1
22	Sphagnum capillifolium	V 11.2 3-29	IV 18.4 5-60	V 10.9 10-15	IV 6.3 7-12	V 30.0 15-55	V 13.8 3-40	II 1.4 2-5	II 0.3 1
23	Sphagnum magellanicum	IV 6.9 1-45	V 6.2 2-10	V 17.8 4-46	V 17.3 2-40	V 9.7 2-20	V 12.4 2-35	I 1.0 5	II 0.5 2
24	Sphagnum papillosum	V 6.9 1-30	V 12.4 5-25	III 3.2 5-9	IV 4.7 1-13	V 16.0 5-30	IV 12.0 5-35	II 6.0 15-15	II 0.8 3
25	Hypnum cupressiforme	V 8.1 1-35	IV 6.0 5-15	V 8.7 1-26	II 1.3 4	II 0.7 2	III 11.0 2-50	IV 6.2 1-15	II 0.3 1
26	Sphagnum cuspidatum	III 1.3 1-5	V 4.4 2-10	V 46.7 25-65	IV 14.3 8-35		II 1.4 2-5	III 16.6 3-50	IV 5.8 1-20
27	Polytrichum formosum	I 0.04 1			IV 2.0 1-5	II 0.7 2	I 1.0 5	II 4.2 1-20	II 0.3 1
28	Oxycoccus palustris	I 0.1 1-1	II 0.4 1-1	IV 0.8 1-2	V 1.3 1-2	V 4.0 2-5	IV 1.0 1-2	III 0.8 1-2	III 0.5 1-1
29	Aulacomnium palustre	I 0.2 1-3		II 3.3 1-10	V 5.7 2-10	V 15.3 8-28	V 8.2 1-30	IV 8.8 1-40	II 2.5 10
30	Sphagnum recurvum var.mucr				IV 1.0 1-2	II 1.7 5	IV 6.0 5-13	III 10.4 2-45	III 1.3 2-3
31	Myrica gale						V 51.8 1-100	IV 4.4 2-10	V 6.3 2-10
32	Betula pubescens					IV 0.7 1-1	I 0.4 2	V 60.0 5-100	
33	Pleurozium schreberi			I 0.2 1	V 20.0 2-55		I 1.0 5	I 14.6 73	
34	Empetrum nigrum							II 8.2 1-40	II 0.3 1
35	Pteridium aquilinum							II 2.6 5-8	
36	Eurhynchium praelongum							III 3.4 1-15	
37	Vaccinium myrtillus							III 4.4 1-20	
38	Juncus effusus							II 3.8 7-12	II 1.3 5
39	Dryopteris carthusiana						I 0.2 1	V 1.6 1-3	IV 1.0 1-2
40	Sphagnum palustre							IV 11.8 3-28	IV 15.8 5-50
41	Molinia caerulea			I 0.5 3	IV 3.7 1-10		I 18.8 94	V 9.0 2-23	V 95.0 80-100
42	species	dry	wet	hu.-ho.	transit. soak	Eriophorum vagi	Myrica gale	Betula pub.	Molinia caer.

This table does not include the species that occur in only one relevé.
The information in this table consists of three parts:
The first part shows the presence (times present in total number of relevés).

I = 0 - 20%
II = 21 - 40%
III = 41 - 60%
IV = 61 - 80%
V = 81 -100%

The second part is the average abundancy of the total number of relevés.
The third part represents the lowest and highest occuring abundancies.

Fig. 1

VEGETATION MAP OF PART OF CLARA BOG

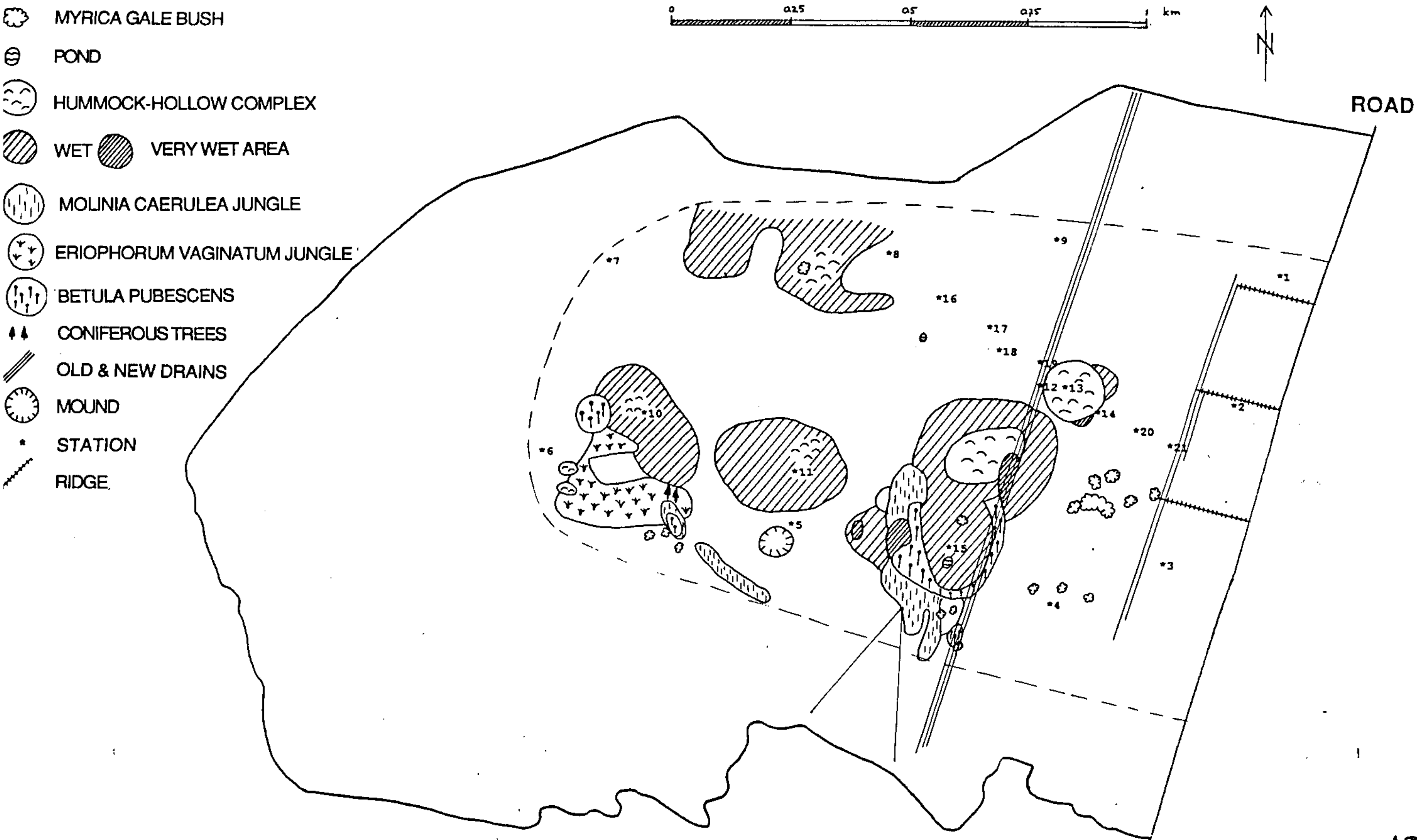

Fig. 2

CROSS-SECTION TRANSECT

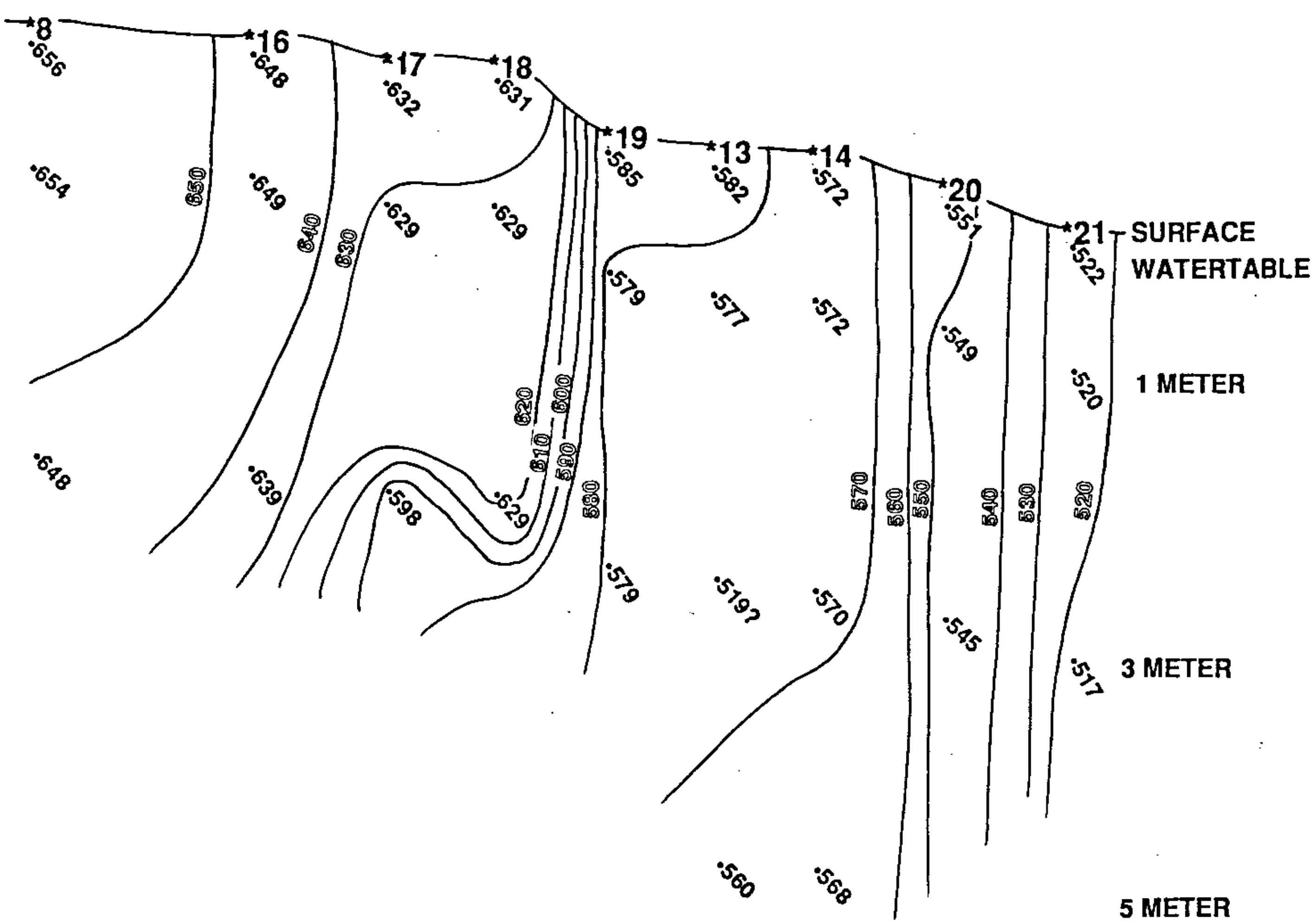

Fig. 3

CONTOUR MAP

(cm. above local datum surface)

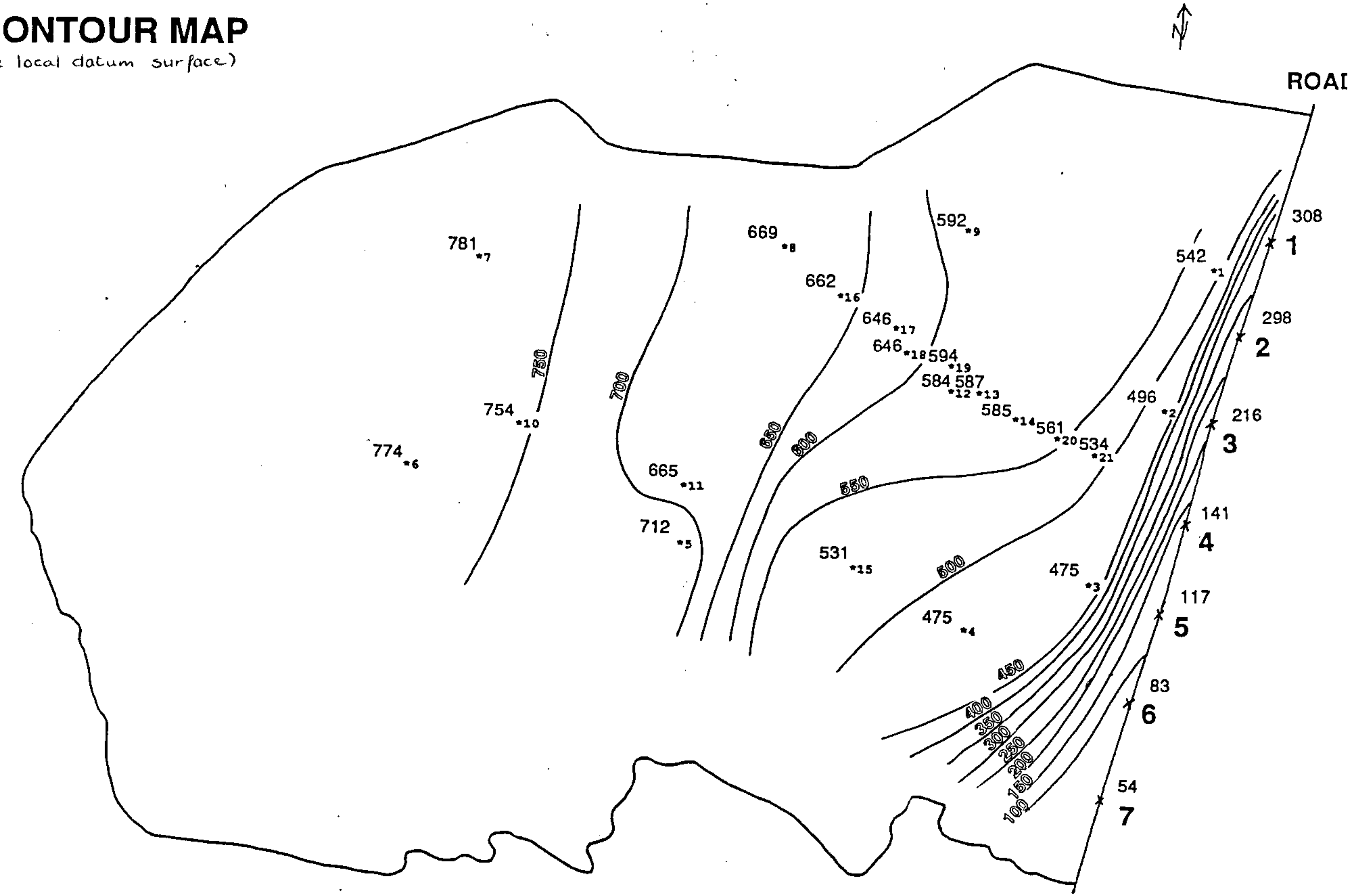

Fig. 4

WATERTABLE MAP

(cm. above local datum surface)

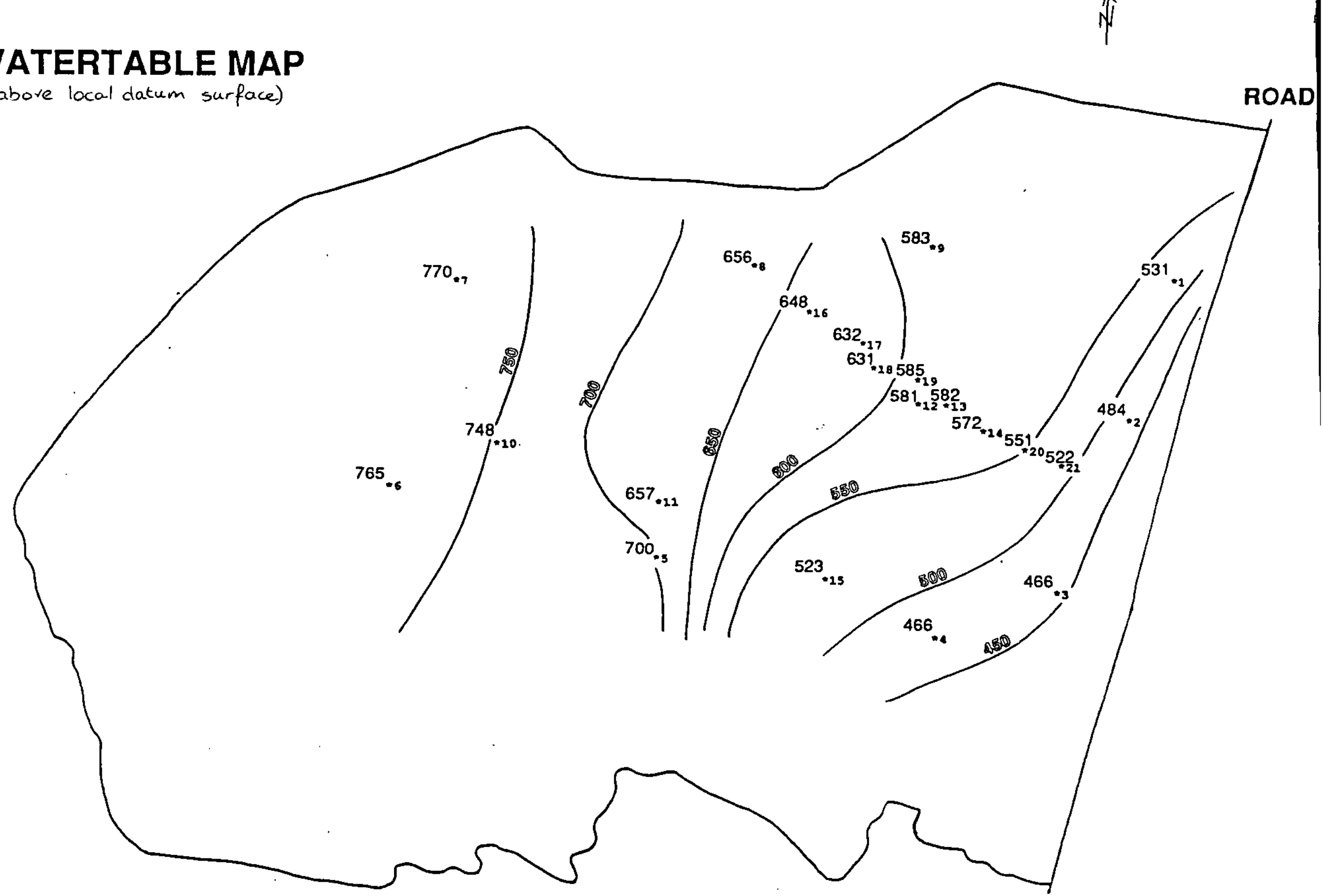

Fig. 5

PIEZOMETER MAP 1 METER

(cm. above local datum surface)

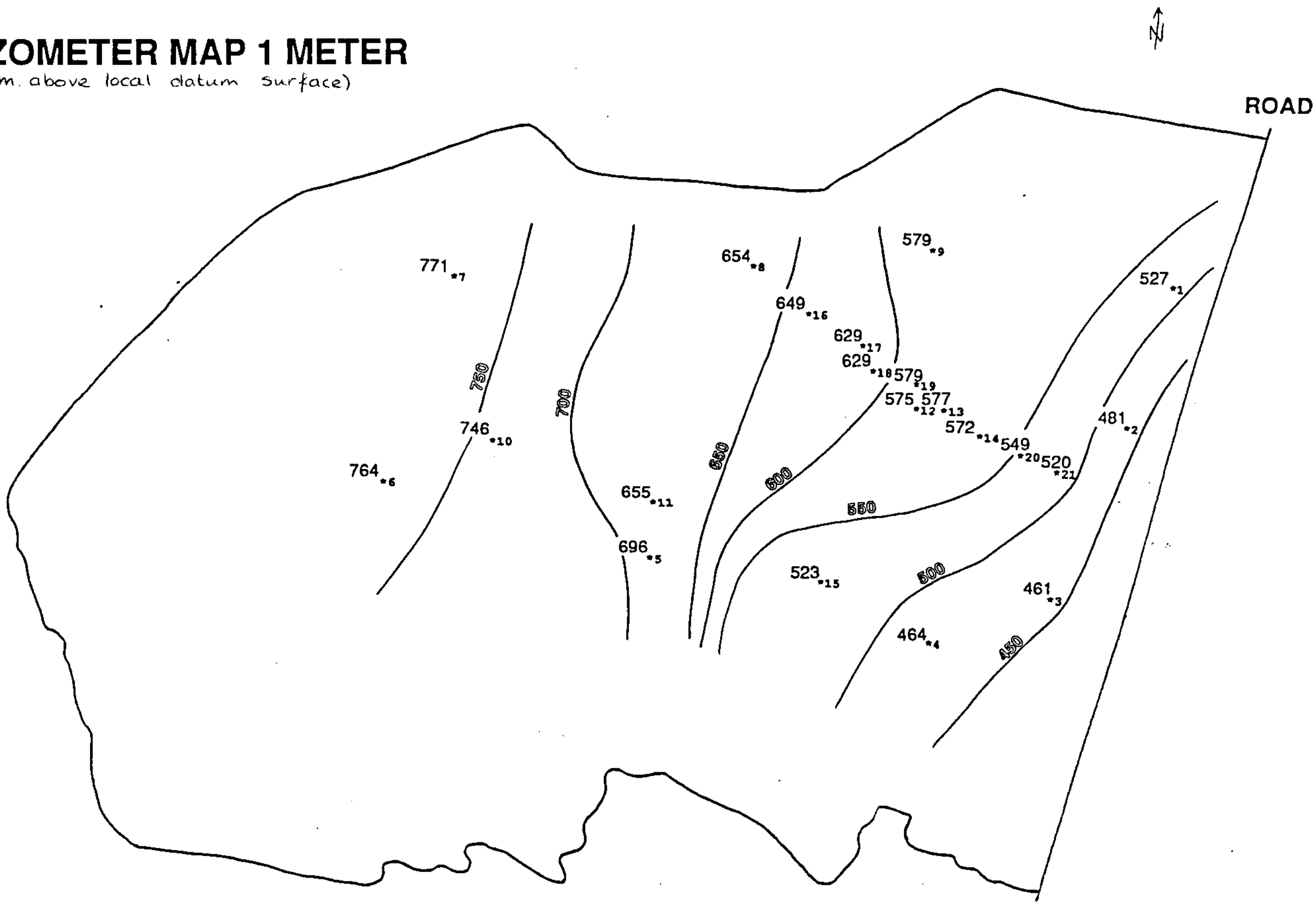

Fig. 6

PIEZOMETER MAP 3 METER

(cm. above local datum surface)

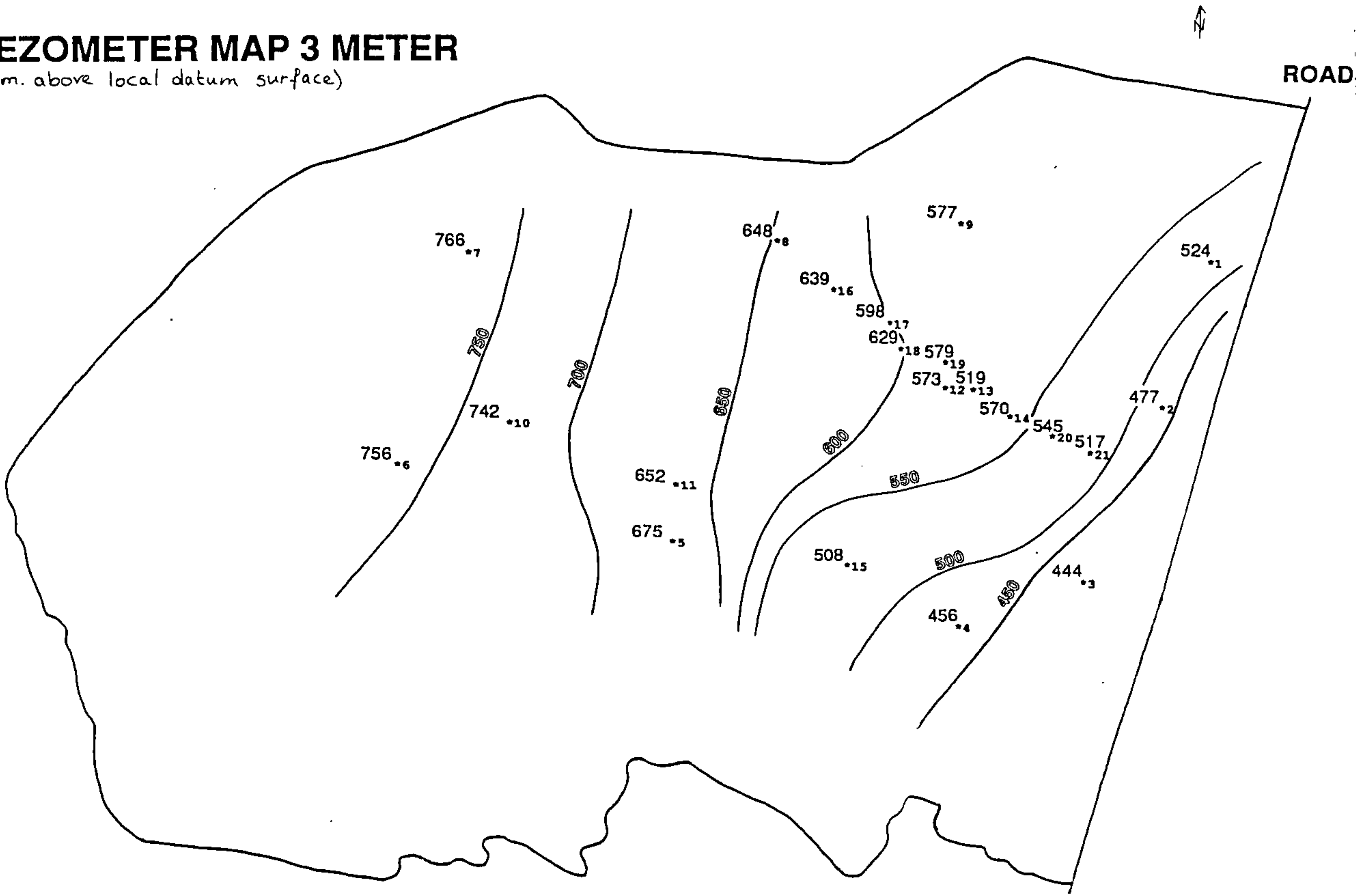

Fig. 7

CHEMISTRY OF DIPWELL WATER

EDGE__DRY__WET__HU-HO__SOAK