SOIL FACTORS AFFECTING PLANT DISTRIBUTION ON A SUCCESSIONAL GRAVEL POND SHORE LINE

IN PARTIAL FULFILLMENT OF
PLANT ECOLOGY REQUIREMENTS
PROFESSER J.W. MARR

BY
JAMES SCOTT HEPPLER

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The use of empty gravel pits for wild-life refuges is but one small part in the reclamation of industrially depleted lands. These pits are filled with water and are revegetated artificially or naturally in order to provide breeding places and year round habitates for various fauna. Initial vegetation is critical as it affects the future development of the ecosystem. The vegetation a gravel pit can initially support may differ from a naturally occurring pond, since the gravel pit soil has been physically altered by man. The purpose of this study is to examine the soil of a gravel pit and it's resultant effects on vegetation composition and distribution.

The ponds selected for study, are collectively called the Sawhill Ponds. They are located east of Boulder, Colorado at 40° 02' N. latitude and 105° 11' W. longitude; and have an average altitude of 5130 feet above sea level. All ponds were surveyed for incoming plant species. The final study area was selected on the following criteria: (a) it contained most of the incoming plant species in a small area, (b) it is one of the youngest ponds in the study area, mining having been stopped in 1961. The actual site is a small southwestern bay in one of the eastern-most ponds (See Map 1).

The inclined shore of the bay, a successional ecosystem in itself, is between the stable _Apyrogroyon elongatum_ community of the plains and the _Typha latifolia_, _Myiophyllum sp._ of the pond. Daubenmire would classify this area as a pond, due to the continous plant cover extending from the shallows to the uplands. The relatively shallow bay has a small eastern opening to the rest of the lake and contains three small islands. These three factors break-up all incoming waves. Wave dispersion may account for the patches of _T. latifolia_ on the western sides of the islands. Plant distribution is shown in Map 2.

Random soil samples were originally taken to determine an area that would show the most soil differentiation along the ecosystem gradient. The areas of the final soil samples are shown in Map 2. The soil transect is labeled B' with the samples occuring at 2 foot intervals, each consisting of the top 3 inches of soil. The samples were then analyzed by the colloidal suspension method for the percentages of various partical sizes. The results are given in table 1. Total soil composition is diagramed in figure 1 for ease of comparison. Samples A', U and W were taken because they represented areas of interest that could later be compared to the B' soil transect. Sample A', taken on top of a peninsula, should be representative of the mounds of earth deposited in the bay. Sample W was taken underneath the only woody plant in the area, a Salix amygdaloides. Sample U represents undisturbed soil taken in an unmined area. Finally, a vegetation transect 1 foot by 20 feet was taken in the area coinciding with the B' soil samples. The results are diagramed in figure 2.

A prime reason for the varying particle composition of the B' soil transect is the 45°incline which levels out before entering the water. The higher percentages of smaller particles shown by sample B'9, resulted from the original aluvial flood plain and subsequent wind deposition of small particles. Between sites B'8 and B'3, a shift toward increasing percentages of smaller particals is seen. This could be explained by the fact that larger particles will have a tendency to break loose and roll downhill (Daubenmire). Since sites B'3 and B' 2 have a shallow incline, they "catch" the larger particles form the upper sites. This results in increased percentages of larger particles at B'2 and B'3. In underwater site B'1, the percentages of larger particles, at the upper 3 inches of soil, decreases since larger particles tend to settle in the lower soil layers. The overall particle distribution on the B' incline may account for the distribution of the various species.

Another factor that could contribute to plant distribution on the incline, is previous soil compaction by heavy equipment. The immediate effect of soil compaction would be to limit the establishment of plants whose roots could not penetrate the upper soil layer. Within several years, the upper soil layers should loosen up and become penetrable by roots. A second, more lasting effect of compaction on the lower soil layers is the inhibition of capillary rise of water. Compacted soils do not carry moisture as high as loose soils. (Baver).

Nowhere in the study area does Typha latifolia extend above shoreline. There are two possible reasons for this. First, the increase of rock, silt and clay percentages at the expense of the silt percetage may be detrimental to T. latifolia development. Secondly, it is known that Typha requires a moist environment to develope. Perhaps the B'2 - B'3 soil doesn't draw enough water through capillary rise for T. latifolia establishment.

Artemesia filifolia and Asclipias speciosa are hardy plants that require little water. Soil compaction doesn't seem to affect their distribution. The wide range of particle distribution between sites B'2 and B'8 is evidence of this. Due to the inclination of these sites, most precipitation probably runs downhill before it has a chance to be absorbed by the soil. Inhibited capillary rise of water due to soil compaction, would also restrict the various types of vegetation this area could support. The above factors probably account for the similarities in the vegetation of the B'2 - B'8 incline and the islands in the bay.(Compare B'3 and A factors).

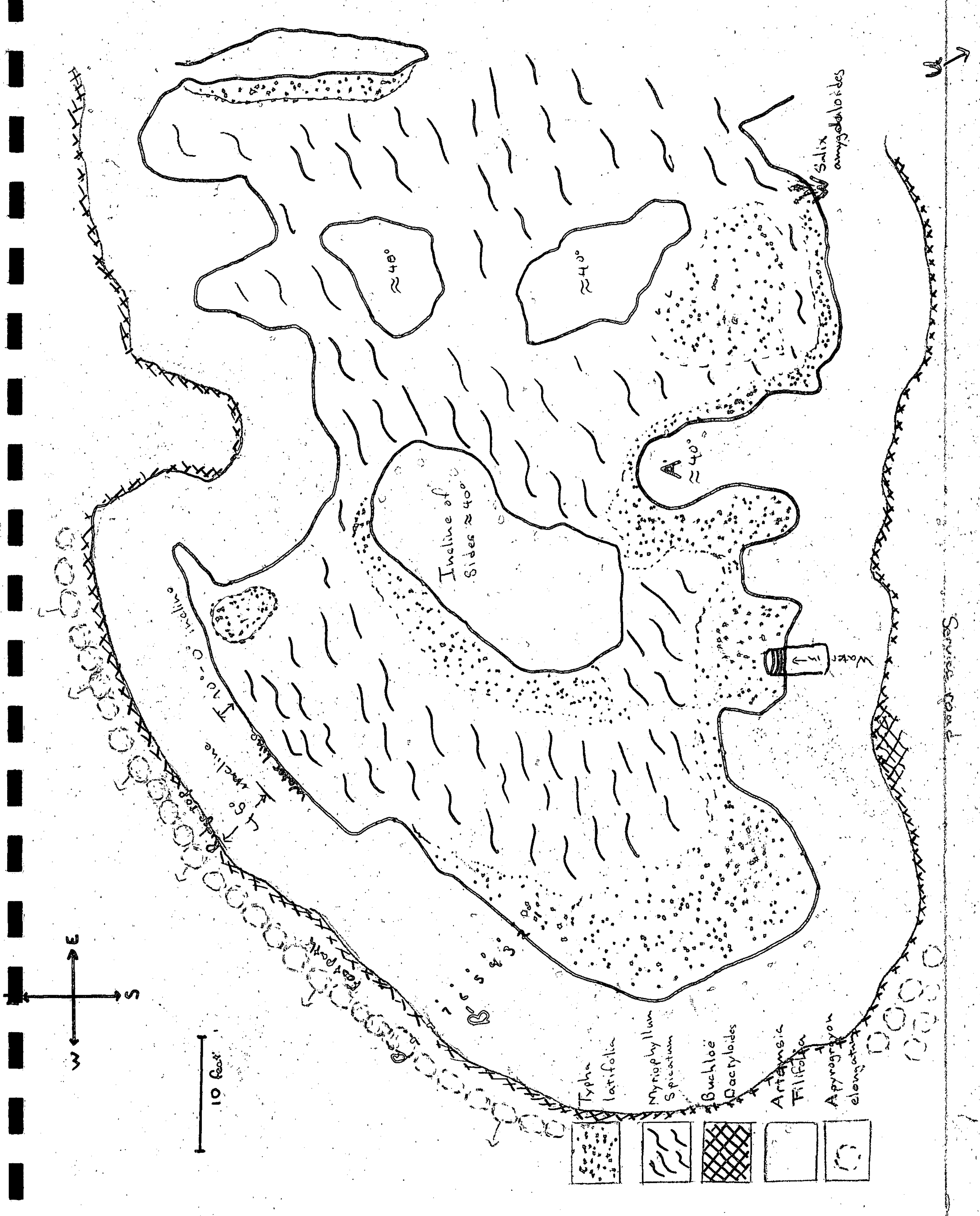
Apryrogroyon elongatum is the grassland dominate on the bordering plains. It has been displaced by *Buchlöe dactyloides* near the foot path since *B. dactyloides* is more resistant to trampling. *A. elongatum* and *B. dactyloides* probably receive enough water from atmospheric precipation, for there is no run-off on flat areas.

From this study it is seen that soil particle composition, density and slope inclination show a correlation to the vegetation distribution on gravel pond shores. Laboratory studies on the relevance of the above correlations could be extremely useful. The City of Boulder, which recently obtained this land, is considering physical modification of the ponds in order to increase waterfowl production. Since waterfowl like reeds such as *Typha latifolia* for nesting sites, this study indicates that one way to increase the amount of this plant would be to build gradual shorelines. The shore line could then be aerated to reduce the affects of compaction. The appearance of *Salix amygloides* in the study area is probably due to chance dissemination. If this is so, more *S. amygloides* could artificially be introduced into the area as it also provides cover for waterfowl. It is fitting that man make these ponds into waterfowl sanctuaries since man has destroyed many of their natural sanctuaries.

Map 1

photo taken Feb 21, 1973

Map 2



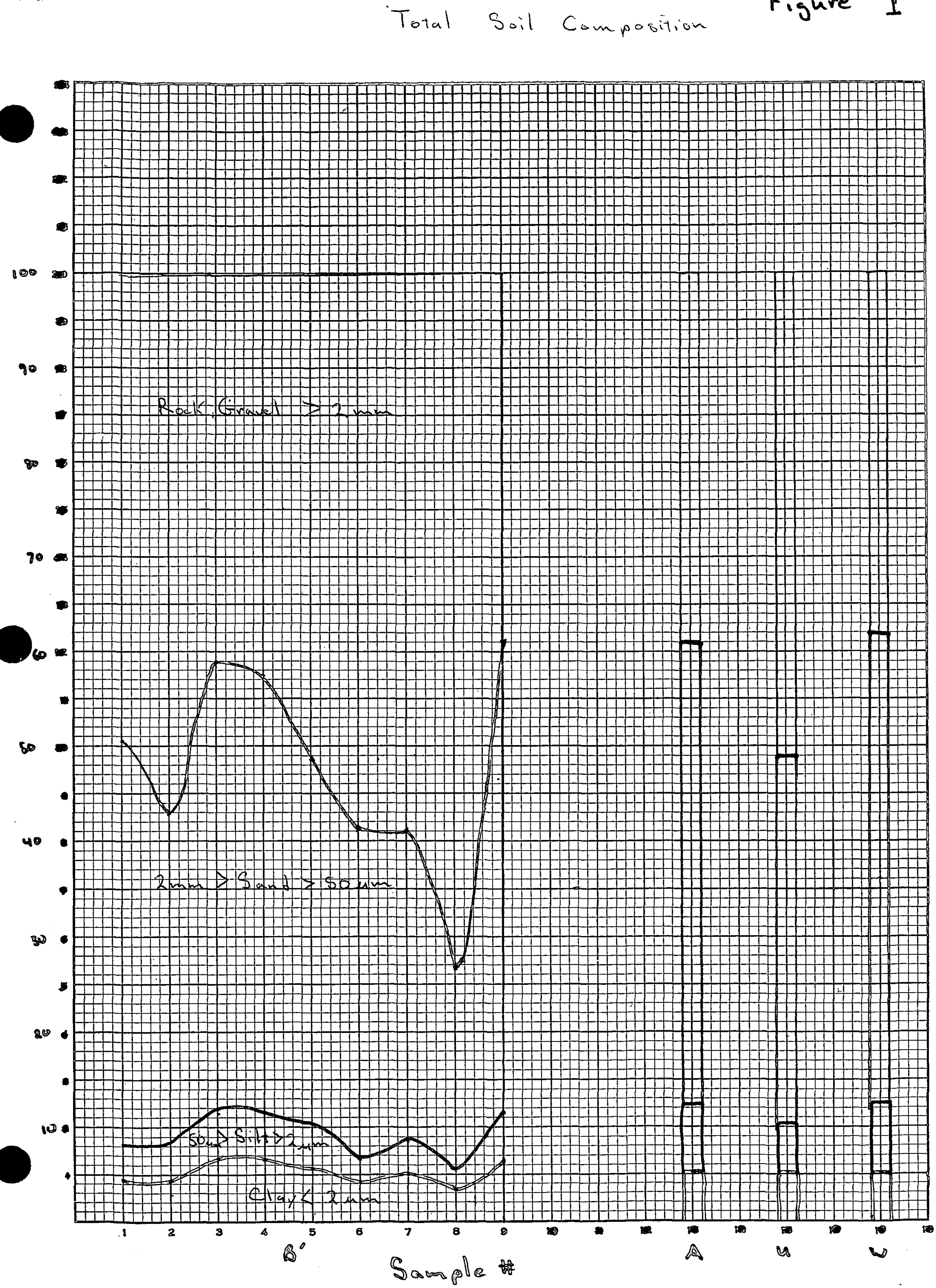
≈48°
≈40°
A ≈40°
Incline of Sides ≈40°
Salix amygdaloides
Water
Service road
10-0° incline
Water line
6° incline
Foot path
E
S
W
10 feet
Typha latifolia
Myriophyllum Spicatum
Buchloë Dactyloides
Artemisia Filifolia
Agropyron elongatum

TABLE 1

PERCENTAGES OF SOIL PARTICLES

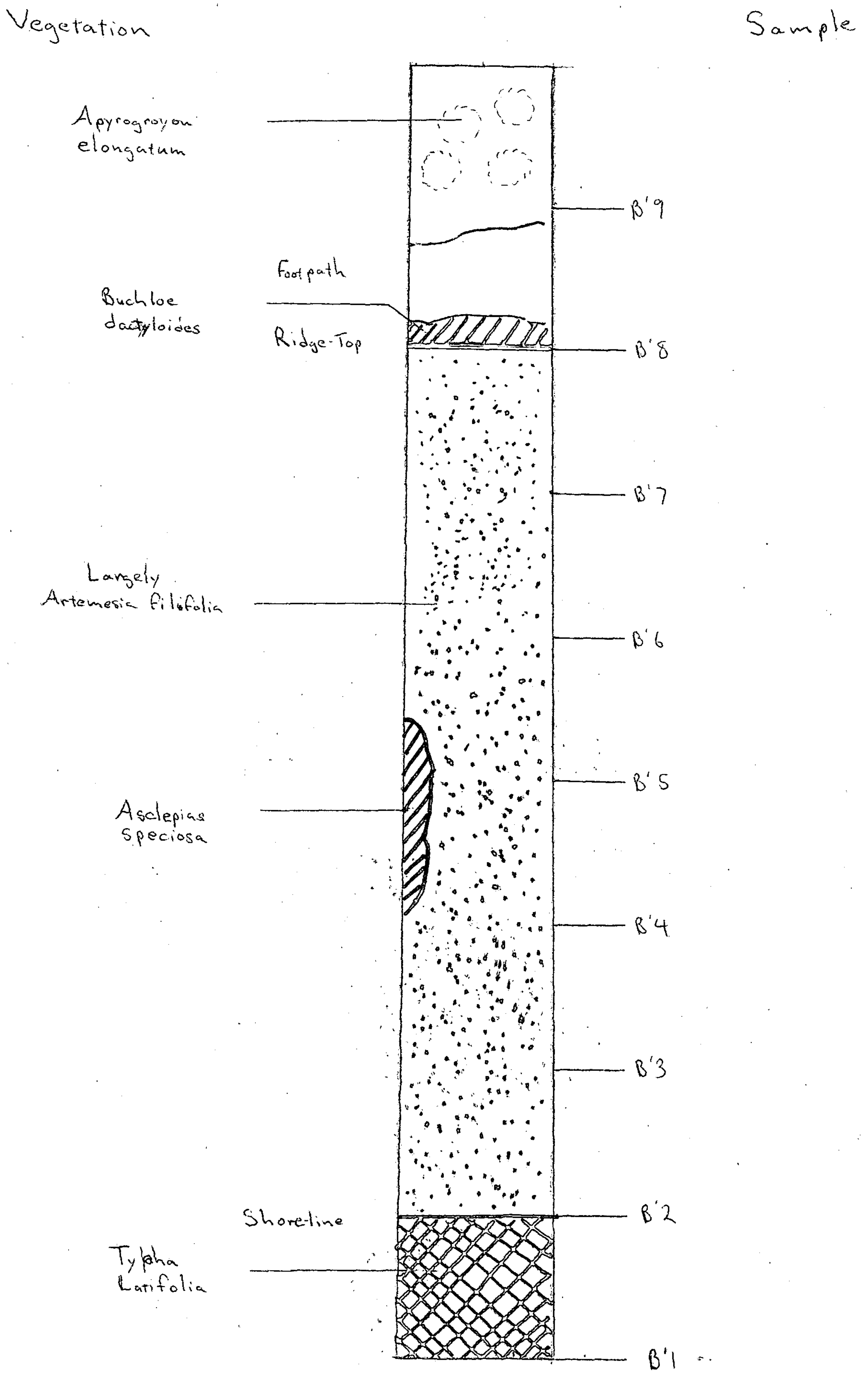
Sample	Size			
	size>2mm	2mm>size>50mu	50mu>size>2mu	size<2mu
B'1	49.5%	42.3%	3.7%	4.5%
B'2	57.0%	34.5%	4.2%	4.3%
B'3	41.0%	47.0%	5.2%	6.8%
B'4	47.5%	40.8%	5.0%	6.7%
B'5	51.5%	38.1%	4.7%	5.7%
B'6	59.0%	34.4%	2,5%	4.1%
B'7	59.0%	32.3%	3.5%	5.2%
B'8	73.5%	20.8%	2.4%	3.3%
B'9	39.0%	49.2%	5.2%	6.6%
A'	39.0%	48.6%	7.3%	5.1%
u	51.0%	38.6%	5.2%	5.2%
W	38.0%	49.4%	7.4%	5.2%

Figure 1



Total Soil Composition
Rock, Gravel > 2 mm
2mm > Sand > 50 um
50um > Silt > 2 um
Clay < 2 um
100
90
80
70
60
50
40
30
20
10
1
2
3
4
5
6
7
8
9
B'
A
u
w
Sample #

Figure 2


Vegetation
Sample
Apyrogroyon elongatum
B'9
Foot path
Buchloe dactyloides
Ridge-Top
B'8
B'7
Largely Artemesia filifolia
B'6
B'5
Asclepias Speciosa
B'4
B'3
Shoreline
B'2
Typha Latifolia
B'1

Facing Northeast ↑

Facing Southeast ↑

Facing Northwest ↑

← Facing Southwest.

Facing West →

REFERENCES

Daubenmire R. Plant Communities - a textbook of plant synecology. Harper and Row, Publishers, N.Y. pg. 131-156.

Baver L.D. Soil Physics John Wiley and Sons, Inc. N.Y. pg 310.