Conclusion

A variety of coastal processes can assist a shoreline in combating erosion, for example, the accumulation of sand to form a beach. Many processes can also hinder a shoreline, like wave action tearing away a bluff face. These processes become more evident and more important when people live along a coastline and come in contact with it in their everyday lives. This is true of Bill Stanton Community Park. Officials and residents of Madison Township want to protect their park from further erosion and preserve it for the future. Speculation existed as to the exact cause for the erosion of the bluff face, and this paper may help officials decide what means to take in slowing erosion at the Park.

The objectives of this research were to determine whether groundwater was an influential factor controlling bluff degradation at Stanton Park, to provide a detailed stratigraphic column of the materials which compose the bluff at Stanton Park, to compare Lake Erie water levels with groundwater levels, and to determine whether most erosion will take place in conjunction with seeps. A recommendation as to the most effective means of retarding erosion at Stanton Park is also made.

Groundwater fluctuations coincide with times of increased erosion and evidence of seeps. Groundwater increased in the late summer to fall months, and then decreased through winter, and then increased until the end of the study (late April, 2002). Seeps were observed in early spring when there was

increased erosion at the base of the bluff face. This erosion occurred in the same saturated zone as the seeps along the bluff face. Lower groundwater heads are also noted at this time because groundwater is discharging as seeps along the bluff.

During the time of this study, wave attack was very minimal to non-existent, except during times of storms, and lake levels never rose to the levels of the bluff. There was also a substantial beach in front of the bluff face during the study time. So, common factors of shoreline erosion, such as wave attack and rising lake levels, can be discounted at Stanton Park. Therefore, groundwater is likely the main factor controlling erosion at the park.

Man-made shore protection structures commonly used along Lake Erie include steel sheet piling sea walls, rip-rap revetments, offshore breakwaters, and shore perpendicular groins or jetties. These structures would not be very effective at Stanton Park if the groundwater is indeed the major cause of bluff erosion. A more effective means of slowing the erosion rate at the park would be to de-water the bluff.

Officials and residents of Madison Township also now have a detailed stratigraphic column of the sediments which compose the bluff and monitoring wells so groundwater can be monitored in the future. Composing a plan to de-water the bluff will be made simpler with these tools.

The hypothesis stated in the Introduction was, for the most part, supported from the research conducted. Groundwater was proven to be the most critical factor controlling bluff loss at Stanton Park, with other factors such as freeze and

thaw, wave action, and changing lake levels playing a role in initiating the slope failure. It is a combination of these influences which are the driving force behind slope erosion. De-watering the bluff was recommended as the most effective way of delaying erosion at the Park. A detailed stratigraphic column was provided in this paper. Most erosion occurring along the bluff face was observed where seeps were located. And finally, Lake Erie water levels were recorded and compared with groundwater levels.

The hypothesis that a correlation exists between changing lake levels and changing groundwater levels was proven to be false, though. Lake Erie water levels did not follow the same pattern as the groundwater levels, and there is no correlation between the two. This is due to the influence of precipitation in other, larger portions of the Lake Erie drainage basin on Lake Erie water levels. This means that the groundwater system controlling bluff erosion at Stanton Park is not tied into Lake Erie water levels.

Officials of Madison Township now have an educated direction to take in planning for their system to retard erosion at Stanton Park.

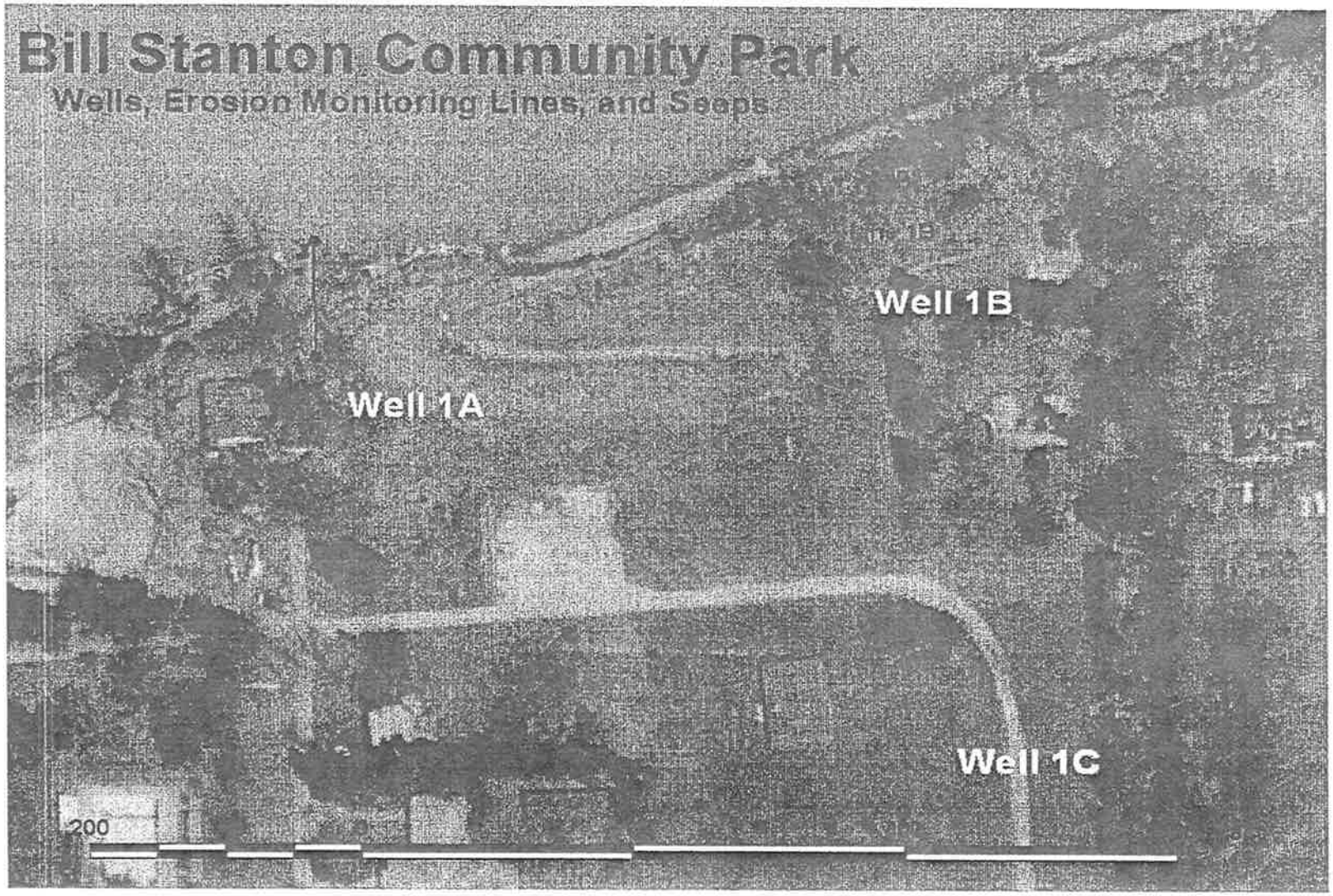
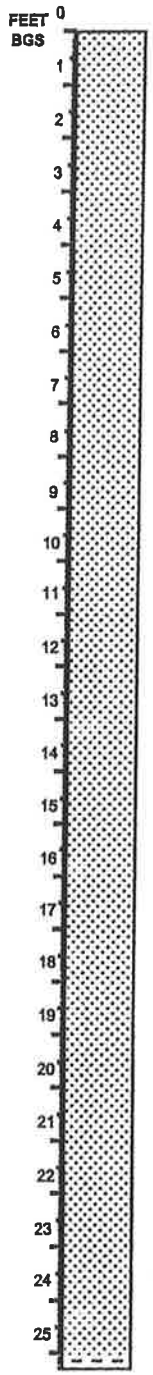


Figure 17. ArcView layout of well, seep, and line locations.

Bill Stanton Park Coring and Monitoring Well Installation
Madison Township, Lake County, Ohio
Well 1A April 2, 2001



0.0' - 0.9' Poorly sorted SAND (10YR 3/4), moist

0.9' – 3.1' Coarse- to fine-grained, moderately sorted SAND (10YR 4/6), moist

3.1' – 11.0' Upper coarse- to upper fine-grained, poorly sorted SAND (10YR 4/6), moist

11.0' – 13.1' Lower medium- to upper fine-grained SAND (10YR 4/4), moist

13.1' – 23.1' Lower very fine-grained, well sorted SAND (10YR 4/4), moist

17.52' – 18.1' Coarse- to medium- and fine-grained, poorly sorted SAND, moist

18.1' – 23.1' Upper to lower very fine-grained, well sorted SAND (10YR 4/4), moist

22.5' – 22.58' Thin, discontinuous, oxidized SAND layers (2.5YR 4/8)

22.9' – 22.98' Oxidized, poorly sorted, medium-grained SAND (2.5YR 3/4), moist

23.1' – 25.03' Fine-grained, well sorted SAND (5YR 5/3), oxidized areas (5YR 4/6), moist

25.03' – 25.13' SILT (5YR 4/4), moist

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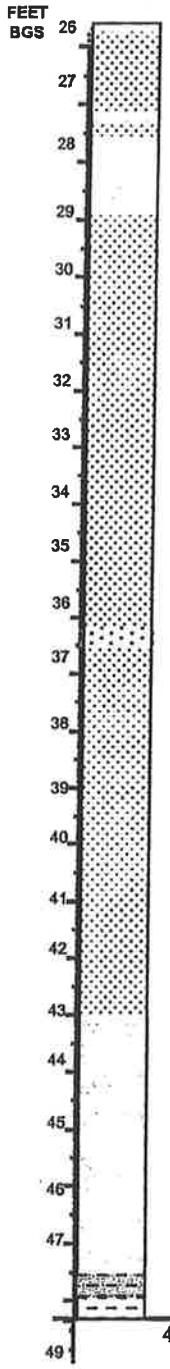
STRATIGRAPHY LEGEND

- Clay
- Silt
- Clay and Silt
- Sand
- Sand and Silt
- Sand (and Silt) Interbedded with Clay
- Rock Fragments
- Topsoil
- Thin Clay layers
- Big Root

Figure 23. Well 1A borehole stratigraphy.

Bill Stanton Park Coring and Monitoring Well Installation
Madison Township, Lake County, Ohio
Well 1A April 2, 2001

Continued



25.13' – 25.28' CLAY (5YR 3/3), moist

25.28' – 27.68' Well sorted, fine-grained SAND (10YR 4/4), wet at bottom

27.28' – 27.38' SILT (10YR 4/1), WET

27.38' – 27.48' Medium-grained SAND (10YR 4/4), moist

27.68' – 28.1' CLAY and fine-grained SAND (10YR 4/1), moist

28.1' – 28.8' CLAY (0.01' thick) and SAND (0.5' thick) interbedded (10YR 4/1), WET

28.8' – 30.15' Upper fine- to lower medium-grained SAND (10YR 4/4), moist

30.15' – 30.57' Medium- to coarse-grained SAND (10YR 4/1), moist

30.57' – 33.1' Fine-grained SAND (10YR 4/1), WET

33.1' – 36.31' Fine-grained, well sorted SAND (2.5Y 4/0), WET

36.31' – 36.8' Medium-grained, moderately to poorly sorted, sand size black rock fragments (Shale? 2.5Y 2/0), WET

36.8' – 38.1' Lower fine- to upper very fine-grained SAND (2.5Y 4/0), WET

38.1' – 43.1' Upper very fine- to lower fine-grained SAND, trace clay in separate small areas (10YR 3/1), WET

43.1' – 47.48' CLAY (0.01' thick) and lower very fine-grained SAND and SILT (0.02' to 0.04' thick) interbedded (7.5YR 4/0), moist

43.1' – 43.4' WET

47.48' – 47.91' Not interbedded, CLAY and SILT (mottled 7.5YR 4/0), moist

47.91' – 48.3' No mottling, SILT (7.5YR 4/0), moist to dry

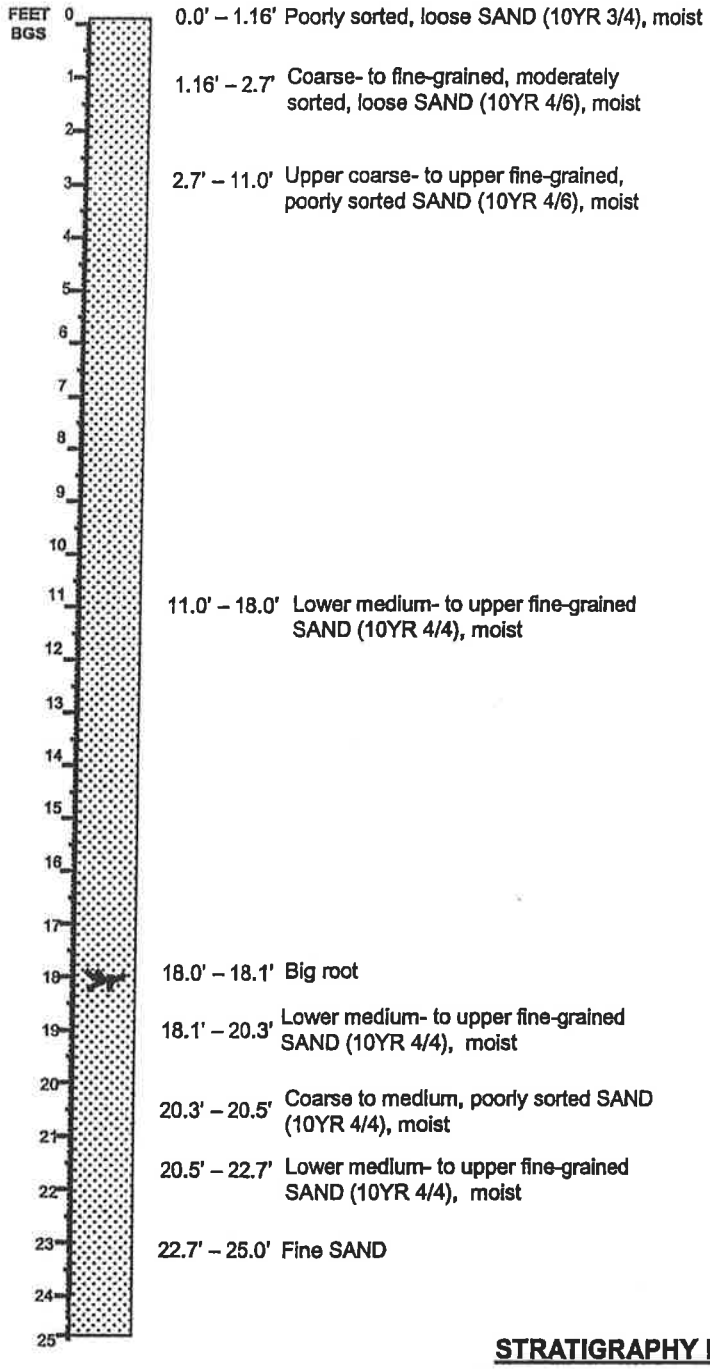
48.3' TOTAL DEPTH

STRATIGRAPHY LEGEND

- Clay
- Silt
- Clay and Silt
- Sand
- Sand and Silt
- Sand (and Silt) Interbedded with Clay
- Rock Fragments
- Topsoil
- Thin Clay layers
- Big Root

Figure 23. Well 1A borehole stratigraphy continued.

Bill Stanton Park Coring and Monitoring Well Installation
Madison Township, Lake County, Ohio
Well 1B April 4, 2001



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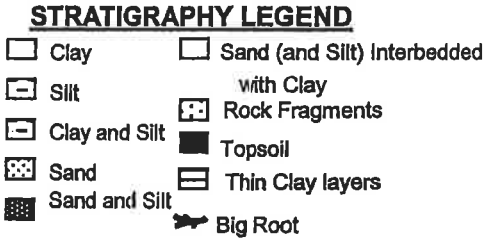
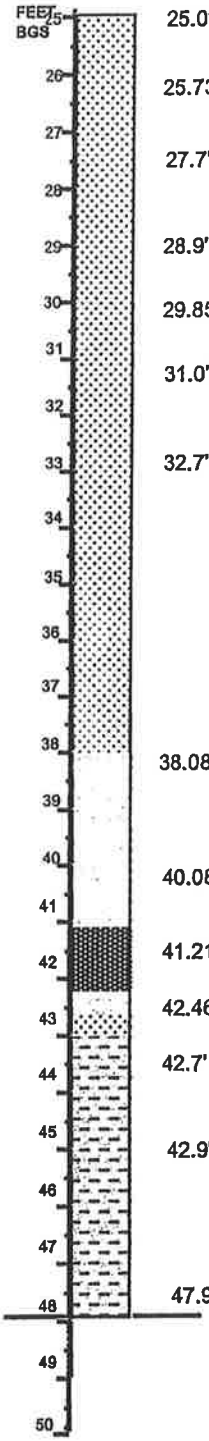


Figure 24. Well 1B borehole stratigraphy.

Bill Stanton Park Coring and Monitoring Well Installation
Madison Township, Lake County, Ohio
Well 1B April 4, 2001

Continued



25.0' – 25.73' Medium SAND

25.73' – 27.7' Fine SAND

27.7' – 28.9' Fine SAND with trace CLAY (10YR 3/6), moist

28.9' – 29.85' Medium SAND with trace coarse SAND

29.85' – 31.0' Fine SAND (5YR 3/2), moist

31.0' – 32.7' Fine SAND (5YR 3/2), WET

32.7' – 38.08' Fine SAND (2.5YR 2/0), WET

38.08' – 40.08' CLAY and very fine SAND and SILT interbedded, WET

40.08' – 41.21' Very fine upper- to fine lower-grained SAND and CLAY, WET

41.21' – 42.46' Very fine SAND and SILT, WET

42.46' – 42.7' Fine SAND and CLAY and SILT (2.5Y 3/0), WET

42.7' – 42.9' Medium SAND, WET

42.9' – 47.9' CLAY and SILT, WET

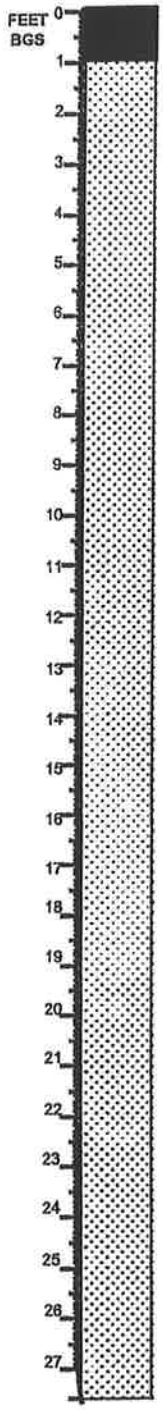
47.9' TOTAL DEPTH

STRATIGRAPHY LEGEND

- Clay
- Silt
- Clay and Silt
- Sand
- Sand and Silt
- Sand (and Silt) interbedded with Clay
- Rock Fragments
- Topsoil
- Thin Clay layers
- Big Root

Figure 24. Well 1B borehole stratigraphy continued.

Bill Stanton Park Coring and Monitoring Well Installation
Madison Township, Lake County, Ohio
Well 1C April 5, 2001



0.0' – 1.09' Topsoil (10YR 2/2)

1.09' – 3.1' Coarse- to fine-grained, poorly sorted, loose SAND (10YR 4/6), moist

3.1' – 5.45' Lower medium- to upper fine-grained SAND (10YR 4/4), poorly sorted, moist

5.45' – 8.8' Lower fine- to upper fine-grained SAND (10YR 4/4), moderately sorted, moist

8.8' – 9.45' Medium SAND (10YR 4/4), moist

9.45' – 13.1' Fine SAND (10YR 5/4), moist

13.1' – 18.1' Lower fine- to upper very fine-grained SAND (10YR 4/4), moist

18.1' – 18.6' Upper very coarse- to fine-grained SAND (10YR 3/4), poorly sorted, moist

18.6' – 27.5' Lower fine-grained SAND (10YR 5/4), moist

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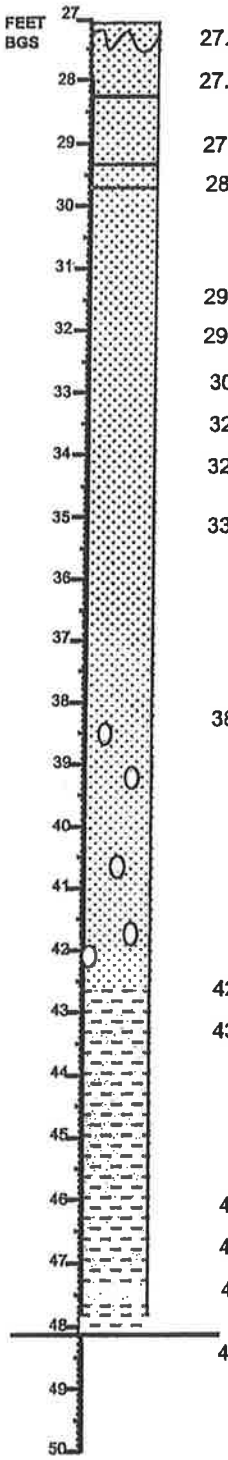
STRATIGRAPHY LEGEND

- Clay
- Silt
- Clay and Silt
- Sand
- Sand and Silt
- Sand (and Silt) Interbedded with Clay
- Rock Fragments
- Topsoil
- Thin Clay layers
- Big Root

Figure 25. Well 1C borehole stratigraphy.

Bill Stanton Park Coring and Monitoring Well Installation
Madison Township, Lake County, Ohio
Well 1C April 5, 2001

Continued



27.50' – 27.51' Wavy CLAY layer (10YR 6/3)

27.51' – 27.98' Lower fine-grained SAND (10YR 5/4), slightly more moist than sand above wavy clay layer

27.98' – 28.1' Lower fine-grained SAND (10YR 5/4), WET

28.1' – 29.86' Very fine-grained SAND with thin CLAY layers (0.01'-0.03' thick), 10YR 5/4, at: 28.44' CLAY streak
29.20-29.22' CLAY layer, WET
29.51-29.57' CLAY layer, WET

29.86' – 29.93' Medium-grained SAND (10YR 5/4)

29.93' – 30.39' Lower fine-grained SAND (10YR 5/4), moist

30.39' – 32.58' Lower fine-grained SAND (10YR 3/2), WET

32.58' – 32.74' Coarse SAND (10YR 3/3), WET

32.74' – 33.1' Medium SAND (10YR 3/3), WET

33.1' – 38.1' Upper very fine-grained SAND (2.5Y 3/2), WET; some or all may be fallback

38.1' – 42.77' Lower fine- to lower very fine-grained SAND with scattered CLAY patches (2.5Y 2/0), WET

42.77' – 43.1' CLAY and SILT (2.5Y 2/0), WET

43.1' – 47.41' CLAY and SILT interbedded (2.5Y 3/2), moist

47.41' – 47.80' CLAY (2.5Y 3/2)

47.80' – 48.0' CLAY and SILT interbedded (2.5Y 3/2)

48.0' – 48.1' SILT, some CLAY (2.5Y 3/2)

48.1' TOTAL DEPTH

STRATIGRAPHY LEGEND

- Clay
- Silt
- Clay and Silt
- Sand
- Sand and Silt
- Sand (and Silt) Interbedded with Clay
- Rock Fragments
- Topsoil
- Thin Clay layers
- Big Root

Figure 25. Well 1C borehole stratigraphy continued.

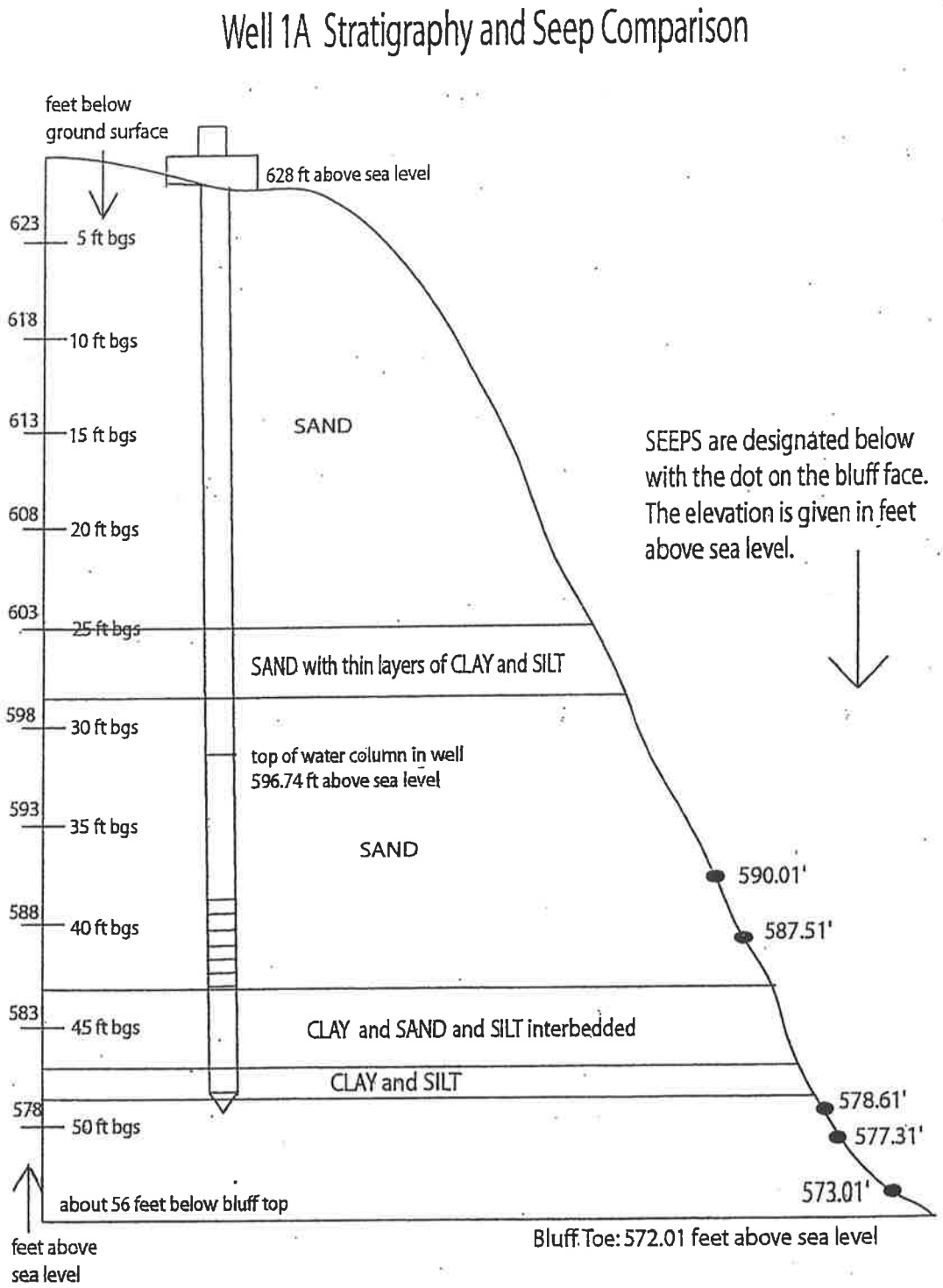


Figure 26. Diagram of Well 1A Stratigraphy and Seeps along bluff face.

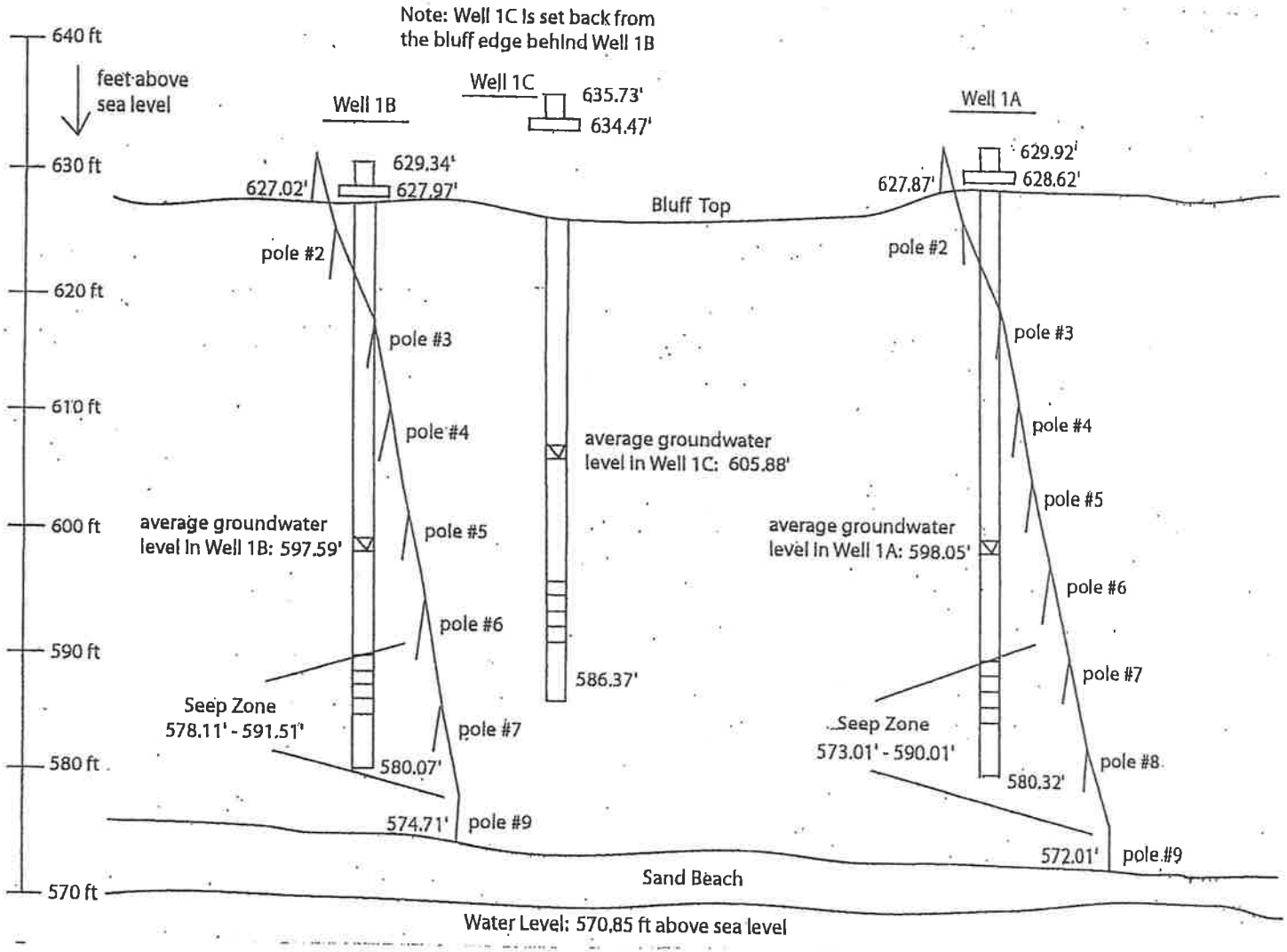


Figure 27. Diagram of the bluff at Bill Stanton Community Park. All measurements are in feet above sea level.