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COMPUTING VISIBLE AREAS FROM PROPOSED RECREATION DEVELOPMENTS... a case study

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Abstract: A new computerized technique called VIEWIT for measuring the terrain visible from a given point was applied in a study on the Black Hills National Forest, South Dakota. The seen area from 12 heavily visited scenic points and along three proposed routes for a scenic tramway were delineated. The computer produced overlay maps that show the maximum area visible from each observation point.

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Retrieval Terms: recreation settings; planning and design; vista points; scenic roads; visible area; esthetic values; visibility analysis; visual impact; computer programs; VIEWIT; Black Hills National Forest.

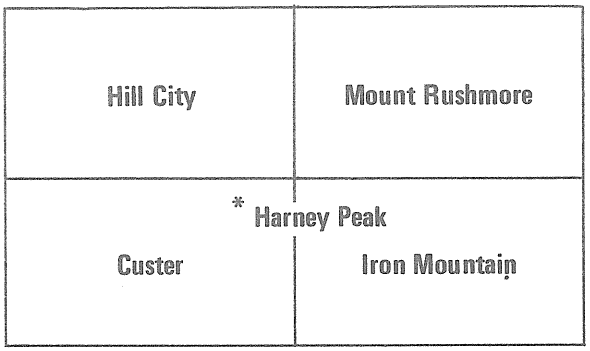
Many types of recreation developments have a strong impact on the environment, including appearance of the surrounding landscape. For example, ski areas, scenic tramways, and scenic road systems usually provide good scenic views of large areas of forest land. The converse is also true—these developments are often visible from large areas. In many cases it may be important to minimize the area from which a development can be seen, such as within "feature landscapes."[1] For other kinds of developments it may be important that they be located so that they either are visible from a large area of land (e.g., national monuments) or provide a view of a large area (e.g., scenic viewpoints). Consequently, the amount of visible area is often an important consideration in judging the feasibility of proposed recreation developments on National Forests.

This note describes the application of a new computerized technique called VIEWIT[2] for measuring the visual impact of proposed recreation developments. In this case study on the Black Hills National Forest, South Dakota, VIEWIT was used to delineate the seen area from (a) 12 heavily used scenic points, and (b) along three alternative routes for a proposed scenic tramway. In each case, the number of acres visible from a development was computed. Other information, such as times-seen and overlay maps, was developed.

BLACK HILLS NATIONAL FOREST

Each summer, thousands of recreationists visit the Black Hills National Forest. Many of them also visit Mount Rushmore National Monument, which is surrounded by this Forest. The area centering around the tallest mountain east of the Rockies—Harney Peak—was used as a study area to illustrate possible visual impacts of hypothetical large-scale recreation developments, including three proposed scenic tramway routes.

First, four U.S. Geological Survey quadrangles of topography around Harney Peak were digitized and recorded as 45,152 elevation points or data cells. The area, covering about 139,971 acres, includes Hill City, Mount Rushmore, Custer, and Iron Mountain. The four quadrangles are made up as follows.



Each of the 45,152 elevation points represents about 3.1 acres, with the elevation recorded to the nearest 100 feet. (This level of accuracy should be kept in mind when interpreting the results.)

Next, for each visibility analysis an elevation point was selected as the observer position, and other cells were checked for visibility from this cell by a computerized technique called VIEWIT. Using this same approach we defined the visible area along each of three proposed tramway routes by simply doing a single-point analysis at each point along a route.

Figure 1 is a schematic map of the Harney Peak area to the same scale as each analysis figure. Additional information can be gained by overlaying this figure with each figure produced by the computer. The map as well as the computer output figures each measured 33 inches by 45 inches before reduction.

To illustrate what points are visible from the top of Harney Peak, analysis was made with the "observer" at the top of the Peak. The overlay results showed that visible areas comprise 101,016 acres or 72.17 percent of the total area analyzed *(fig. 2)*. Of this total visible area, 72.886 percent (73,627 acres) is within a 6-mile radius *(fig. 3)*.

SCENIC ROADWAY VIEWPOINT ANALYSIS

The area visible from 12 heavily visited observer points on roadways in the Harney Peak area was defined *(fig. 4)*. Only one cell or 3.1 acres could be seen from 8 of the 12 observer points, but 18 percent of the land in the four quadrangles can be seen from one of the 12 observer points *(table 1)*. The analysis also showed that 10 percent of the land can be seen from two of the 12 observer points. Therefore, slightly more than 28 percent of the total land area can be seen either once or twice from these 12 positions.

SCENIC TRAMWAY ANALYSIS

In the second part of this study, the visible area along each of three proposed scenic tramway routes to the top of Harney Peak was delineated by using the VIEWIT technique. The visible area along tramway Route 1 was defined by doing 23 separate visibility analyses (i.e., each elevation data point along the route was used as an observer position, except the Peak itself, which was not analyzed for any of the routes because it was included in an earlier analysis). The patterns of visible terrain and the times a point was seen from each route were illustrated in a series of computer printouts *(figs. 5-7)*.

The analysis provided additional information on the times land areas are seen from the routes *(table 2)*. For instance, although Route 3 is much shorter (18 points compared with 23 for Route 1 and 27 for Route 2) it has significantly more terrain seen once or twice than Route 2 and slightly more than Route 1. A total of 19,917 acres can be seen from Route 1; 19,293 acres from Route 2; and 20,327 acres from Route 3. These acreage computations provide a basis for comparing the alternative routes in terms of total area seen from the routes and total area from which the routes can be seen. On a wider scale these results might be compared with analyses of proposed tramways elsewhere.

Other kinds of planning information can be generated by overlaying these figures over maps

Table 1–*Elevation points in study area, acreage, percent of map total, and number of times each point is seen from the 12 observer positions, Black Hills National Forest*

Times seen	Elevation points	Area	Percent of map total
	Number	*Acres*	
0	31,312	95,843.3	69.343
1	8,162	24,983.2	18.077
2	4,783	14,640.3	10.593
3	736	2,252.8	1.530
4	122	373.4	.270
5	31	94.9	.069
6	3	9.2	.007
7	2	5.1	.004
8	1	3.1	.002

Table 2–*Number of times each elevation point is seen from each of three proposed tramway routes, elevation points, acreage, and percent of map total, Black Hills National Forest*

Times seen	Route 1 (23 observer points)			Route 2 (27 observer points)			Route 3 (18 observer points)		
	Elevation points (No.)	Area in acres	Percent of map total	Elevation points (No.)	Area in acres	Percent of map total	Elevation points (No.)	Area in acres	Percent of map total
0	38,645	118,288.9	85.589	38,849	118,913.4	86.040	38,511	117,878.8	85.292
1	4,887	14,958.7	10.823	3,988	12,206.9	8.832	4,766	14,588.3	10.555
2	611	1,870.2	1.353	880	2,693.6	1.949	957	2,929.3	2.120
3	242	740.7	.536	637	1,949.8	1.411	198	606.1	.439
4	102	312.2	.226	344	1,053.0	.762	150	459.1	.332
5	161	492.8	.357	82	251.0	.182	166	508.1	.368
6	115	352.0	.255	54	165.3	.120	99	303.0	.219
7	103	315.3	.228	83	254.1	.184	65	199.0	.144
8	57	174.5	.126	43	131.6	.095	62	189.8	.137
9	60	183.7	.133	37	113.3	.082	76	232.6	.168
10	47	143.9	.104	50	153.0	.111	35	107.1	.078
11	12	36.7	.027	40	122.4	.089	17	52.0	.038
12	17	52.0	.038	35	107.1	.078	6	18.4	.013
13	5	15.3	.011	14	42.9	.031	4	12.2	.089
14	18	55.1	.040	12	36.7	.027	40	122.4	.089
15	12	36.7	.027	1	3.1	.002	–	–	–
16	13	39.8	.029	2	6.1	.004	–	–	–
17	7	21.4	.016	0	.0	.000	–	–	–
18	18	55.1	.040	0	.0	.000	–	–	–
19	15	45.9	.033	0	.0	.000	–	–	–
20	5	15.3	.011	0	.0	.000	–	–	–
21	–	–	–	0	.0	.000	–	–	–
22	–	–	–	1	3.1	.002	–	–	–

showing urban settlements, existing transportation systems, and other large recreational areas.

This type of approach in quantifying visual impact is highly flexible in terms of examining many alternative plans. Of course, much effort is required in collecting and recording carefully the required data and in preparing the necessary computer programs. But once this type of data has been collected, it needs to be updated only infrequently. This approach is now being used by the Forest Service in studies ranging from analyzing the impact of winter sports sites to the study of scenic rivers.

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NOTES

[1]Litton, R. Burton, Jr. *Forest landscape description and inventories–a basis for land planning and design.* U.S.D.A. Forest Serv. Res. Paper PSW-49, Pacific SW. Forest & Range Exp. Sta., Berkeley, Calif. 64 p, illus. 1968.

[2]Amidon, Elliot L., and Gary H. Elsner. *Delineating landscape view areas–a computer approach.* U.S.D.A. Forest Serv. Res. Note PSW-180, Pacific SW. Forest & Range Exp. Sta., Berkeley, Calif. 5 p., illus. 1968.

The Author

GARY H. ELSNER is in charge of forest recreation research. He earned a B.S. degree (1962) at the University of Arkansas, and M.S. (1964), and Ph.D. (1966) degrees at the University of California, Berkeley. He joined the forest Service in 1966.

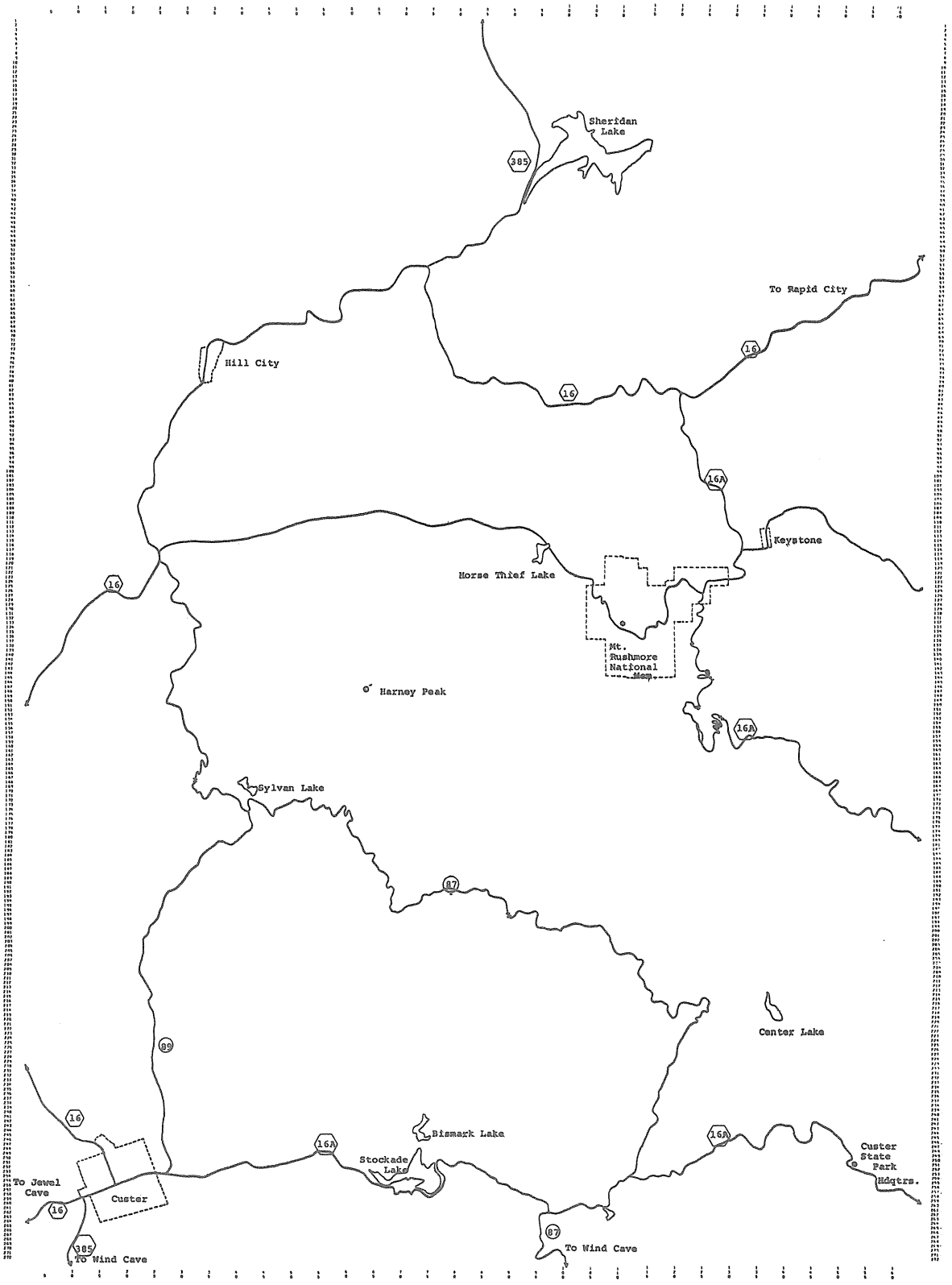

Figure 1—*Harney Peak and adjacent area, on the Black Hills National Forest, South Dakota, served as site of a study on the visual impact of proposed recreation developments.*

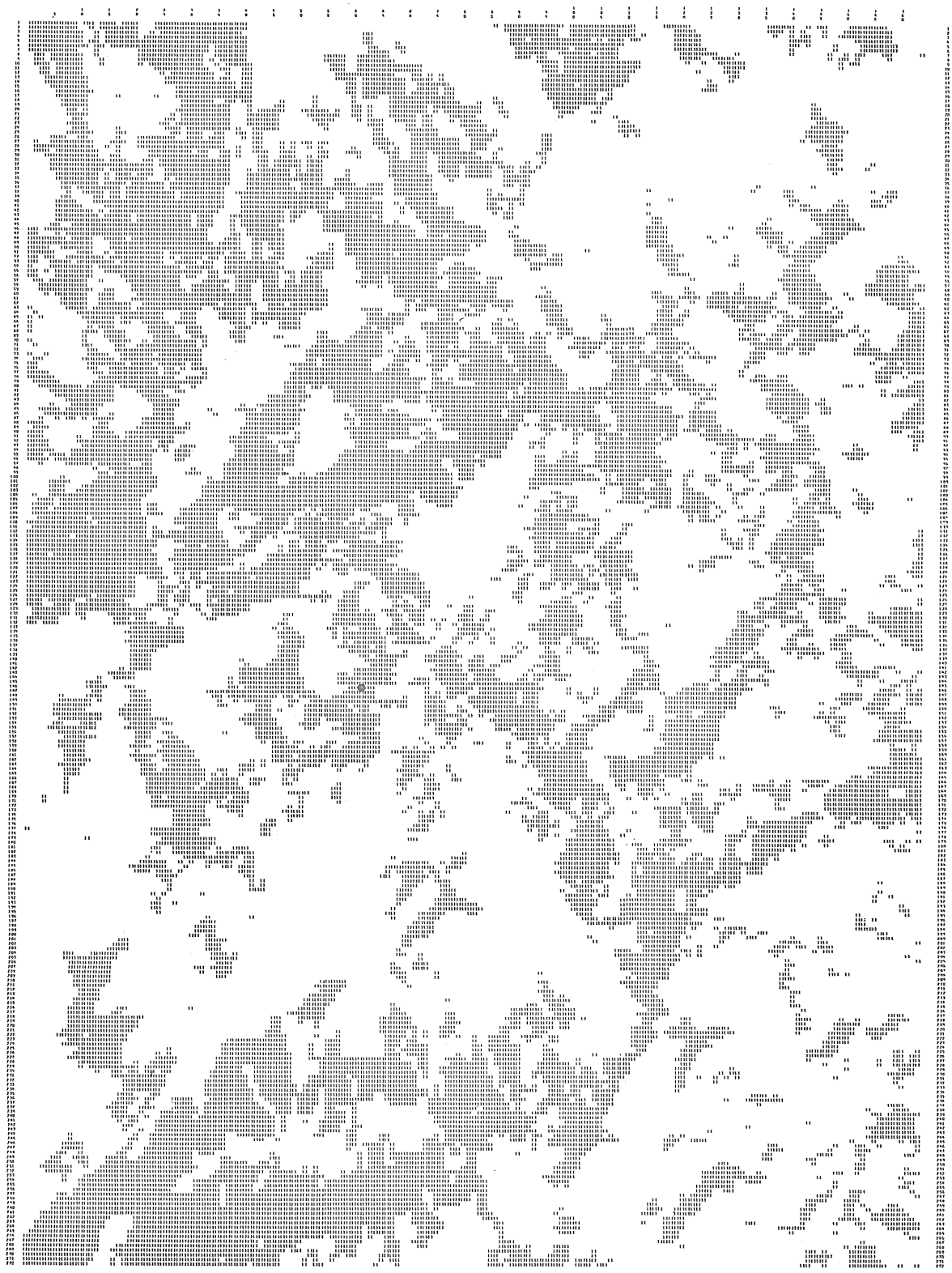

Figure 2—*The number of points visible from Harney Peak totaled 101,016 acres, or 3.1 acres each of the 33,002 observation positions. The points are shown in this map overlay.*

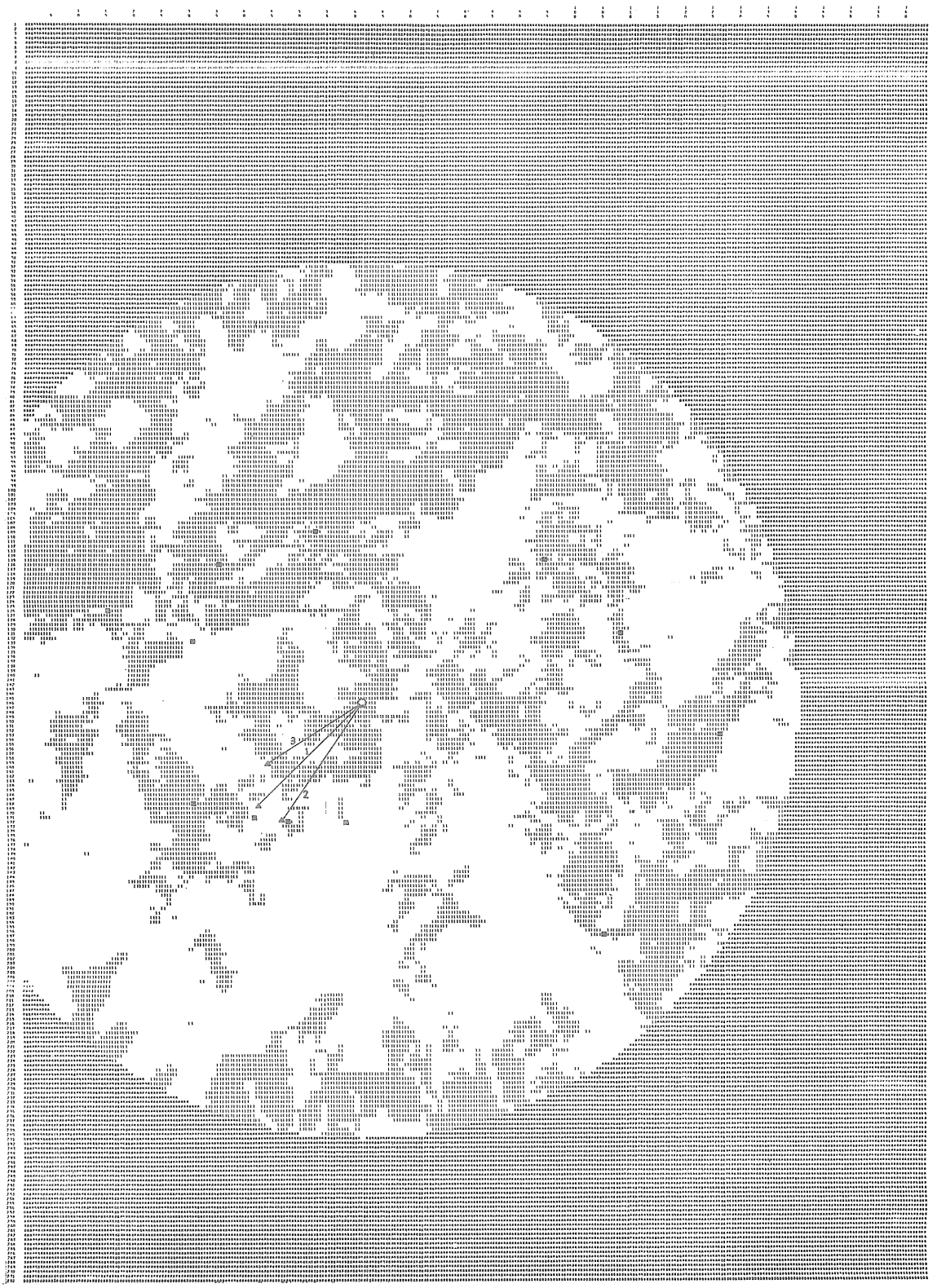

Figure 3—*Area visible within 6 miles from Harney Peak, shown in this map overlay, totaled 24,054 observer positions or 73,627 acres.*

Figure 4—*The number of times elevation points could be seen from 12 heavily used observer positions around Harney Peak was computed and printed on a map overlay.*

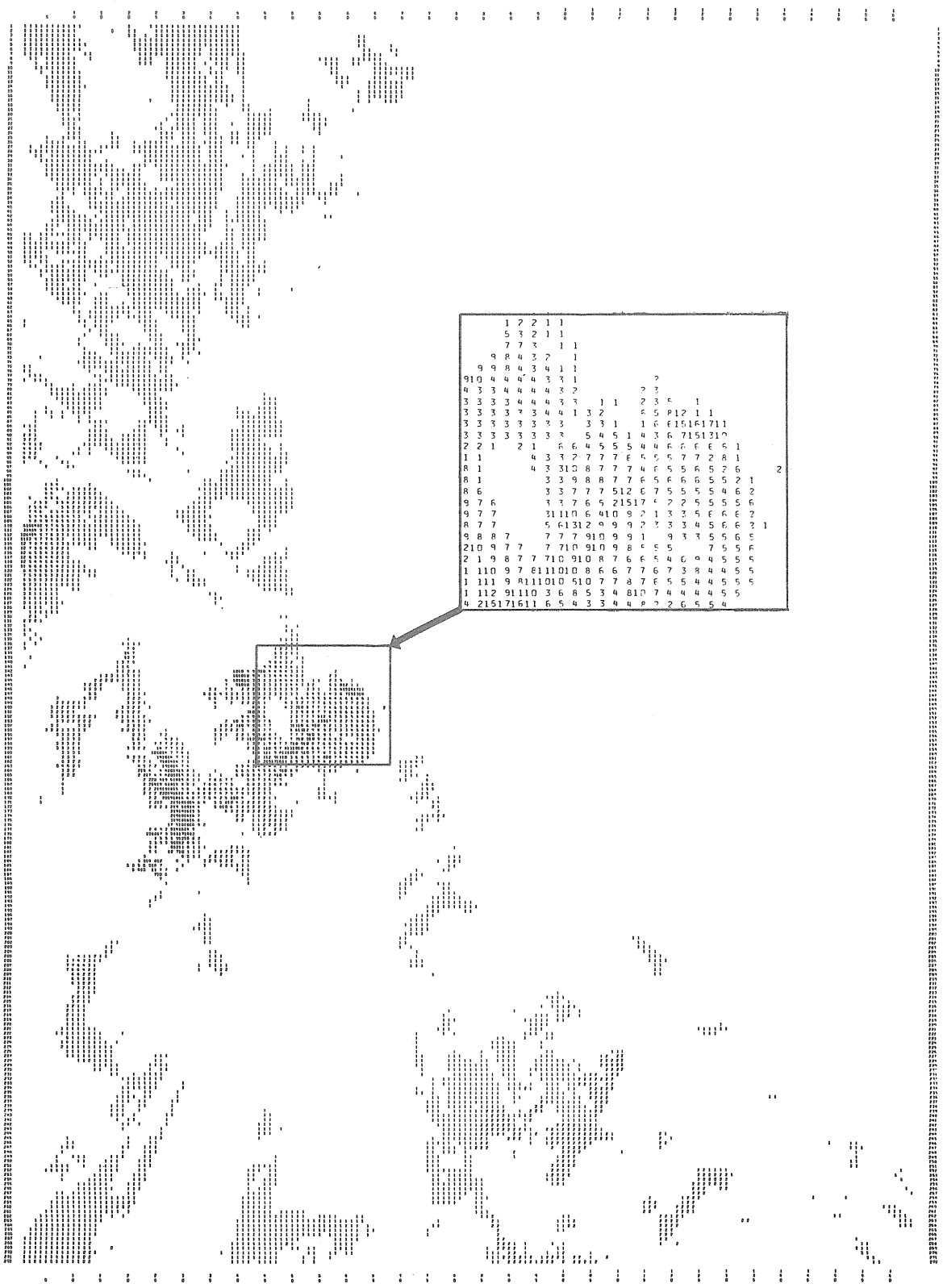

Figure 5—*The number of times elevation points could be seen from 23 observer positions along proposed Tramway Route No. 1 was computed and printed in a map overlay.*

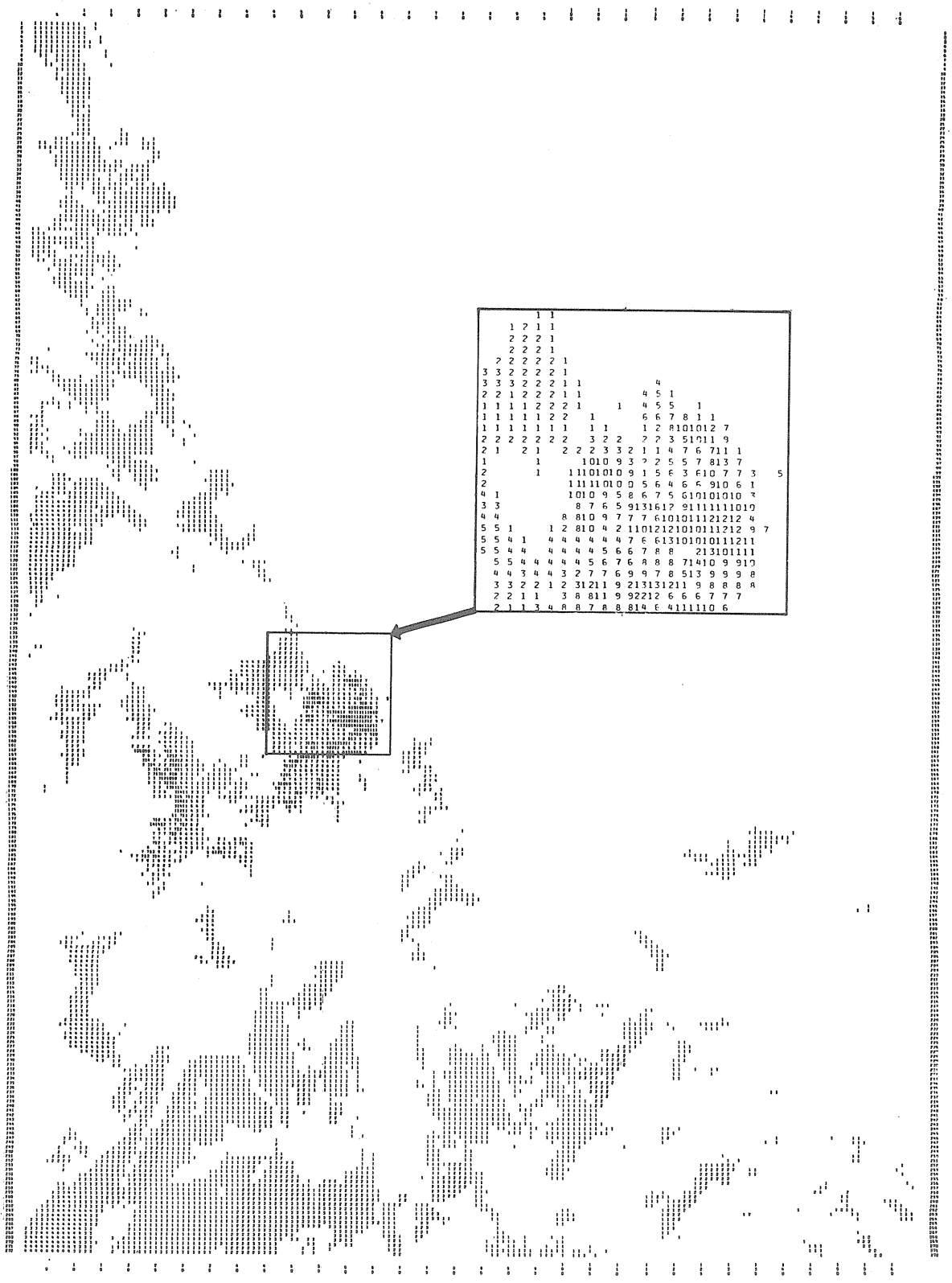

Figure 6–*The number of times elevation points could be seen from 27 observer positions along proposed Tramway Route No. 2 was computed and printed in a map overlay.*

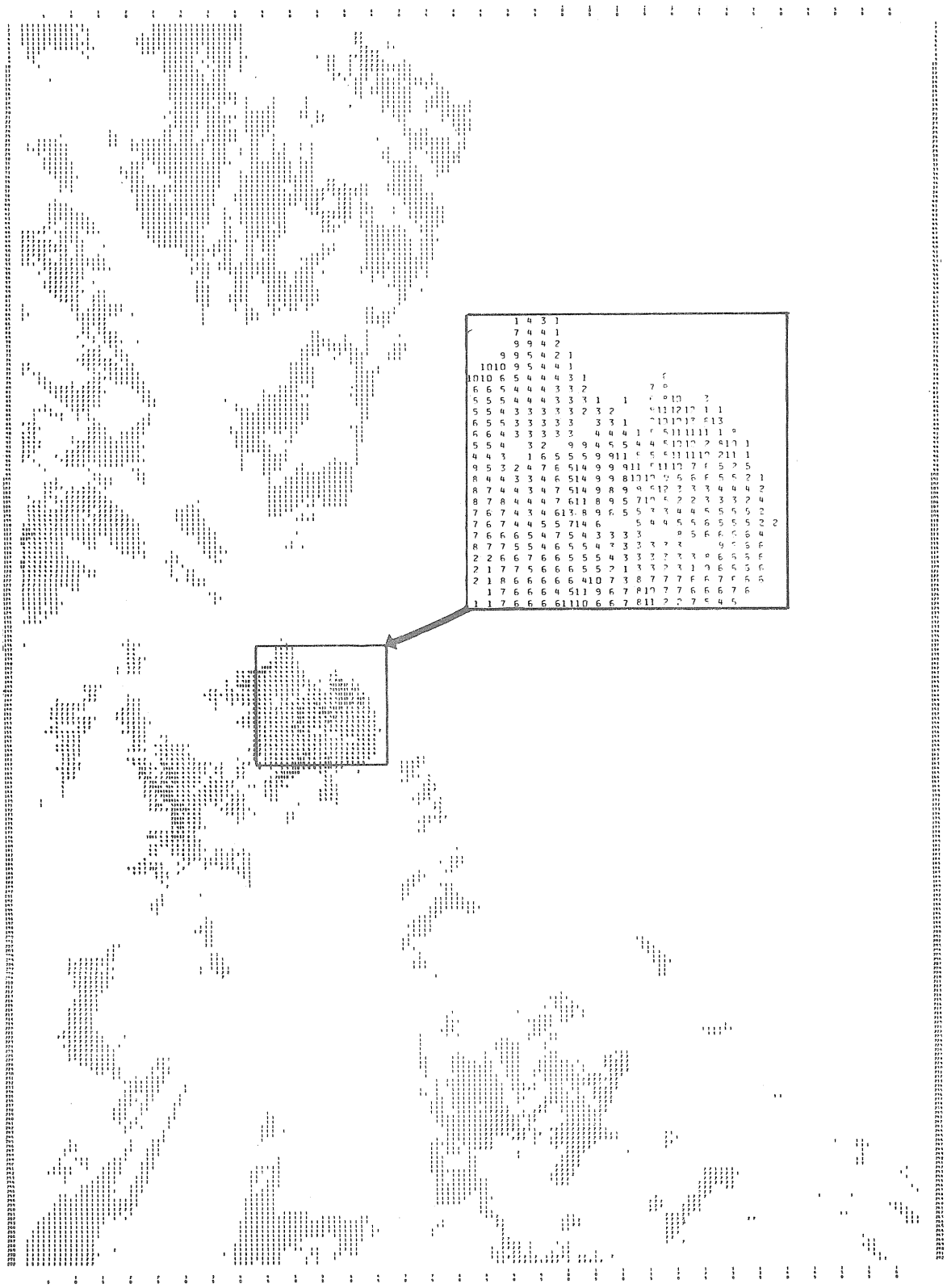

Figure 7—*The number of times elevation points could be seen from 18 observer positions along proposed Tramway Route No. 3 was computed and printed on a map overlay.*

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