PREPARED IN COOPERATION WITH THE DEPARTMENT OF THE NAVY
OFFICE OF NAVAL PETROLEUM AND OIL SHALE RESERVES

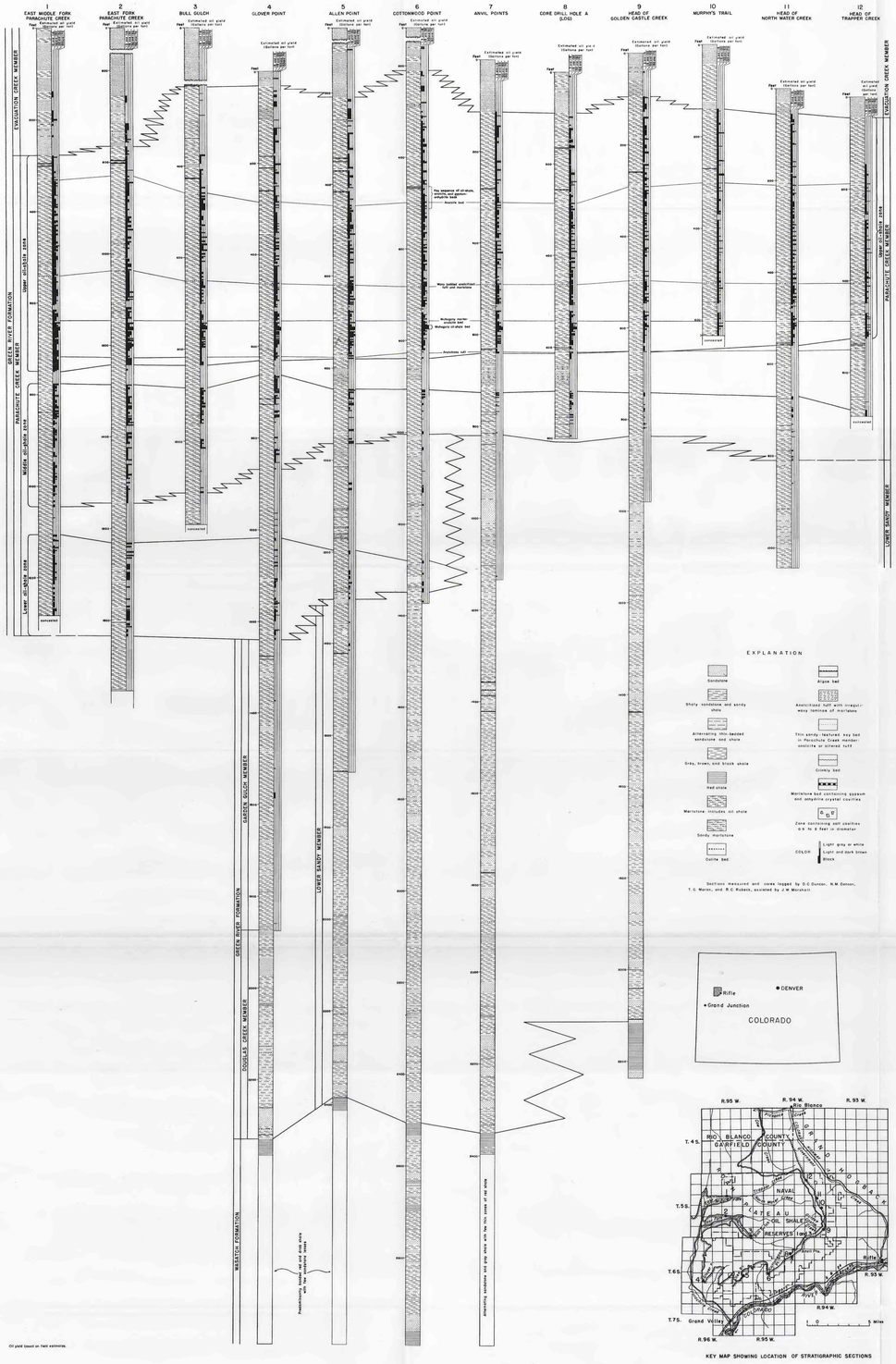

FIGURE 1 COLUMNAR SECTIONS OF PARTS OF THE GREEN RIVER AND WASATCH FORMATIONS, NAVAL OIL SHALE RESERVES 1 and 3, GARFIELD COUNTY, COLORADO
SHOWING CORRELATION OF MEMBERS AND KEY BEDS AND ESTIMATED OIL YIELD

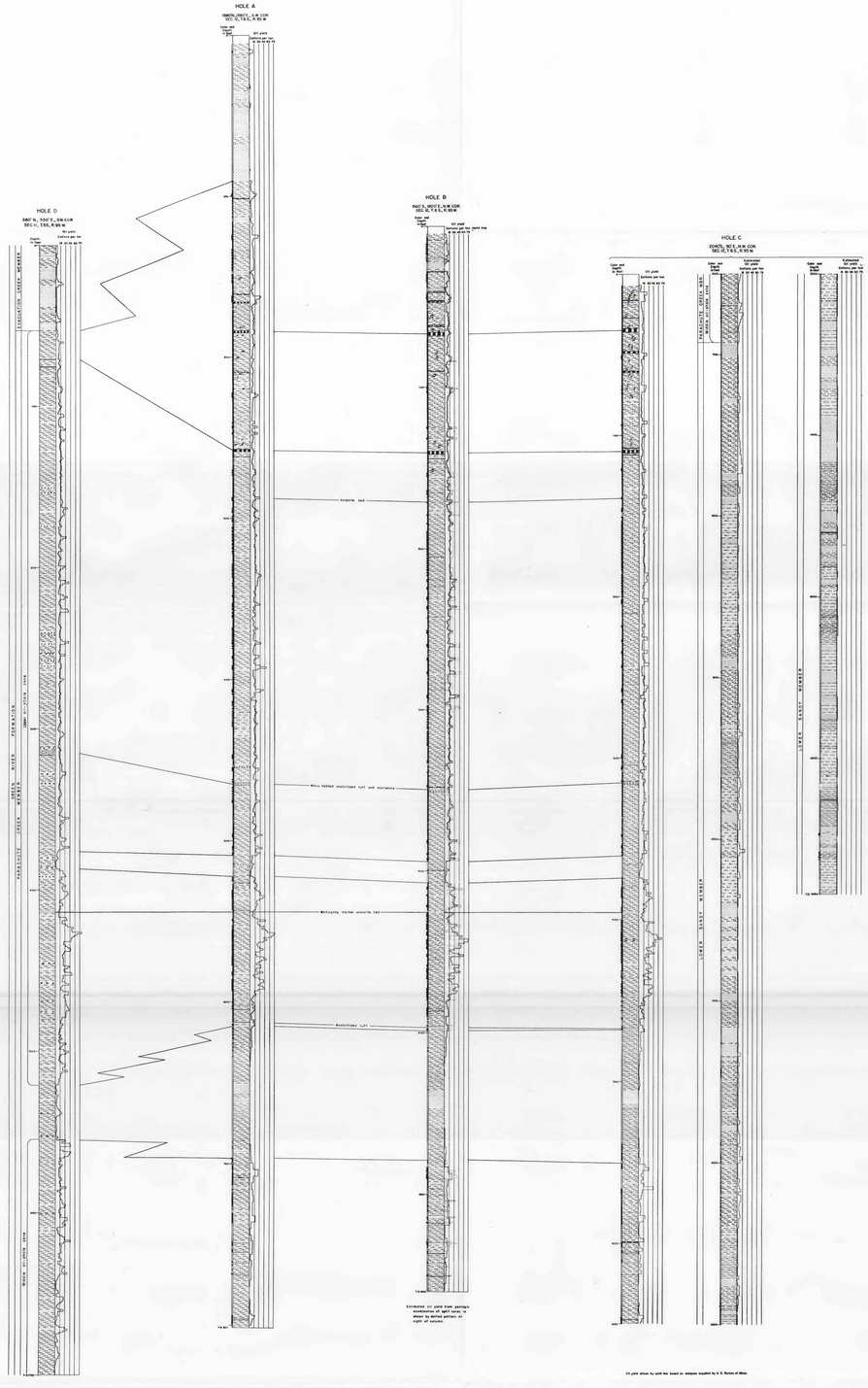

FIGURE 2 DETAILED LOGS OF U.S. BUREAU OF MINES CORE DRILL HOLES IN SEC. 12, T. 6 S., R. 95 W., and SEC. 11, T. 5 S., R. 95 W., NAVAL OIL SHALE RESERVES 1 and 3, GARFIELD COUNTY, COLORADO
SHOWING CORRELATION OF SEVERAL KEY BEDS AND OIL YIELD

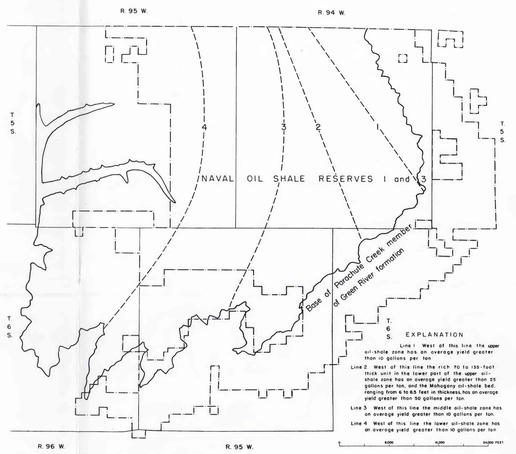

FIGURE 3 MAP SHOWING INFERRED LIMITS OF RICHER AREAS OF THE OIL-SHALE UNITS IN NAVAL OIL SHALE RESERVES 1 AND 3, GARFIELD COUNTY, COLORADO

Table 2. Oil yield of selected units in the rich lower part of the upper oil-shale zone, Naval Oil Shale Reserve, Garfield County, Colorado (based on core analyses of the U. S. Bureau of Mines)

Unit	Core drill hole	Depth in Feet From - To	Thickness in Feet	Oil yield in gallons per ton	Average oil yield in gallons per ton	Average thickness in feet	Potential oil yield in barrels per acre
1 Mahogany oil-shale bed	A	555 - 562	7	59.3			
	B	440 - 448	8	56.3	56.6	7.3	26,000
	C	409 - 416	7	54.9			
	D	525 - 532	7	57.1			32,000
2 Includes Mahogany oil-shale and adjacent beds	A	549 - 569	20	40.6			
	B	435 - 455	20	41.0	40.8	20	54,000
	C	401 - 421	20	40.8			
	D	417 - 438	21	42.6			59,000
3 Includes unit 2 and adjacent beds	A	540 - 590	43	34.7			
	B	435 - 479	45	35.1	34.4	44	103,000
	C	401 - 447	46	33.4			
	D	417 - 478	61	35.0			146,000
4 Includes unit 3 and adjacent beds	A	523 - 596	73	28.7			
	B	400 - 480	70	29.3	28.7	70.3	147,000
	C	375 - 447	72	28.4			
	D	398 - 513	115	29.0			249,000

Table 3. Oil yield of outcrop and underground samples of (a) the Mahogany oil-shale bed and (b) the rich unit in the lower part of the upper oil-shale zone including the Mahogany bed.

Locality	Type of sample	Thickness of bed sampled in feet	Oil yield in gallons per ton	Estimated oil yield of zone represented by sample in gallons per ton
(a) Mahogany bed				
Core drill hole A	Drill core *	7.0	58.5	
Core drill hole B	Drill core *	8.0	56.3	
Core drill hole C	Drill core *	7.0	54.9	
Core drill hole D	Drill core *	9.0	57.1	
Anvil Points stratigraphic section 7	Weathered surface *	6.6	46.8	56
Cottonwood Point stratigraphic section 6	Fresh surface *	8.3	58.8	
Allen Point stratigraphic section 5	Weathered surface *	8.4	43.7	57
East Middle Fork Parachute Creek stratigraphic section 1	Surface †	6.5	57.0	57
(b) Rich unit in the lower part of the upper oil-shale zone including the Mahogany bed				
Core drill hole A	Drill core *	73	28.7	
Core drill hole B	Drill core *	72	29.1	
Core drill hole C	Drill core *	72	29.4	
Core drill hole D	Drill core *	125	29.0	
Anvil Points	Weathered surface *	70.1	22.1	28.9
Cottonwood Point	Fresh surface *	69.1	30.5	30.5
Allen Point	Weathered surface *	72.6	23.6	30
East Middle Fork Parachute Creek	Surface †	120	29.5	30

* Data summarized from U. S. Bureau of Mines analyses.
† Approximation from Columbia Oil Shale & Refining Co., U. S. Geol. Survey Prof. Paper 168, pl. 33, column 2.

Table 4. Estimate of tonnage of oil shale and estimate of amount of oil yield (a) in the Mahogany oil-shale bed and, (b) in the rich unit in the lower part of the upper oil-shale zone, including the Mahogany bed, in the Naval Reserves and in the area lying between the west boundary of the Naval Reserves 1 and 3 and Parachute Creek.

Area of Naval Reserves 1 and 3

	Tract	Area in acres	Average thickness in feet	Short tons in millions	Estimated oil yield: Gallons per ton	Total barrels in millions
Mahogany bed	T. 5 S., R. 94 W.	9,760	7.0	190	50	230
	T. 5 S., R. 95 W.	10,240	7.5	230	35	280
	T. 6 S., R. 94 W.	250	6.0	9	50	11
	T. 6 S., R. 95 W.	6,160	7.5	120	55	170
	T. 6 S., R. 96 W.	490	8.0	11	55	14
	Total	27,000		560		704
Rich unit in the lower 70 to 135 feet of the upper oil-shale zone (includes Mahogany bed)	T. 5 S., R. 94 W.	9,760	70	1,980	35	1,180
	T. 5 S., R. 95 W.	10,240	135	3,750	30	2,660
	T. 6 S., R. 94 W.	250	70	110	35	66
	T. 6 S., R. 95 W.	6,160	135	1,700	30	1,200
	T. 6 S., R. 96 W.	490	135	180	30	130
	Total	27,000		7,900		4,986

Area lying between the west boundary of the Naval Reserves 1 and 3 and Parachute Creek

	Tract	Area in acres	Average thickness in feet	Short tons in millions	Estimated oil yield: Gallons per ton	Total barrels in millions
Mahogany bed	T. 5 S., R. 96 W.	10,480	8.5	250	67	340
	T. 6 S., R. 96 W.	4,720	7.5	120	55	150
	T. 6 S., R. 97 W.	6,780	8.5	180	55	230
	Total	21,980		550		720
Rich unit in the lower 70 to 135 feet of the upper oil-shale zone (Includes Mahogany bed)	T. 5 S., R. 96 W.	10,480	135	3,810	30	2,790
	T. 6 S., R. 96 W.	4,720	70	1,050	30	710
	T. 6 S., R. 97 W.	6,780	100	1,960	30	1,400
	Total	21,980		6,800		4,900

Note: The figures used in the columns showing gallons per ton probably suggest a greater accuracy than the available data justifies. The figures are really relative; for example, oil shale in a township shown as having an average yield of 20 gallons per ton is believed to be somewhat leaner than an adjacent township shown as having an average of 30 gallons per ton, but either figure 20 or 30 might vary 3 gallons, plus or minus.

Table 5. Estimate of tonnage of oil shale and estimate of amount of oil yield in the lower, middle, and upper oil-shale zones in the Naval Reserves 1 and 3 and in the area lying between the west boundary of the Naval Reserves and Parachute Creek.

Area of Naval Reserves 1 and 3

Zone	Tract	Area in acres	Average thickness in feet	Short tons in millions	Estimated oil yield: Gallons per ton	Total barrels (42 gals.) in millions
Lower oil-shale zone	T. 5 S., R. 95 W.	5,980	200	3,430	10	880
	T. 6 S., R. 95 W.	680	200	390	10	88
	T. 6 S., R. 96 W.	620	200	380	10	99
	Subtotal	6,240		4,030		963
Middle oil-shale zone	T. 5 S., R. 94 W.	5,130	180	1,790	10	430
	T. 5 S., R. 95 W.	10,240	225	6,760	15	2,480
	T. 6 S., R. 95 W.	3,965	180	1,140	10	290
	T. 6 S., R. 96 W.	490	180	140	10	34
	Subtotal	19,570		10,290		3,214
Upper oil-shale zone	T. 5 S., R. 94 W.	16,890	660	39,080	13	8,090
	T. 5 S., R. 95 W.	10,240	470	14,540	14	5,780
	T. 6 S., R. 95 W.	680	450	1,960	14	780
	T. 6 S., R. 95 W.	6,160	560	20,000	15	8,310
	T. 6 S., R. 96 W.	490	600	850	15	350
	Subtotal	34,960		76,430		23,310
	Total			90,750		27,487
				68,660		22,187

Area lying between the west boundary of the Naval Reserves 1 and 3 and Parachute Creek

Zone	Tract	Area in acres	Average thickness in feet	Short tons in millions	Estimated oil yield: Gallons per ton	Total barrels (42 gals.) in millions
Lower oil-shale zone	T. 5 S., R. 96 W.	11,960	220	7,630	10	1,980
	T. 6 S., R. 96 W.	5,680	220	4,010	10	960
	T. 6 S., R. 97 W.	7,840				
	Subtotal	25,480		11,640		2,760
Middle oil-shale zone	T. 5 S., R. 96 W.	11,480	280	8,280	18	2,970
	T. 6 S., R. 96 W.	5,660	280	8,440	10	980
	T. 6 S., R. 97 W.	7,840	280	8,970	11	1,010
	Subtotal	30,480		25,690		4,960
Upper oil-shale zone	T. 5 S., R. 96 W.	10,820	475	14,490	18	6,310
	T. 6 S., R. 96 W.	4,710	550	7,080	18	2,480
	T. 6 S., R. 97 W.	6,780	600	11,040	18	3,470
	Subtotal	21,990		32,610		12,260
	Total			69,940		20,020

Note: The figures used in the columns showing gallons per ton probably suggest a greater accuracy than the available data justifies. The figures are really relative; for example, oil shale in a township shown as having an average yield of 14 gallons per ton is believed to be somewhat leaner than an adjacent township shown as having an average of 18 gallons per ton, but either figure 14 or 18 might vary 3 gallons, plus or minus.

GEOLOGY OF NAVAL OIL SHALE RESERVES 1 AND 3, GARFIELD COUNTY, COLORADO

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