U.S. DEPARTMENT OF INTERIOR
U.S. GEOLOGICAL SURVEY

DRILL CORES AND CRUSHED SAMPLES OF OIL SHALE STORED IN THE ANVIL POINTS MINE, GARFIELD COUNTY, COLORADO

by

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Denver, Colorado

Open-File Report 98-45

1998

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Abstract

A cooperative project between the Department of Energy (DOE) and the U.S. Geological Survey (USGS) to move approximately 600 pallets of oil-shale drill cores and crushed core samples from the Geological Survey's Core Research Center in Lakewood, Colorado to the Anvil Points experimental oil-shale mine near Rifle, Colorado, was completed in September 1995. The total cost of the project was $78,841 of which the DOE paid $35,000. During the same month, an additional 76 pallets of oil-shale drill cores were moved from the Federal oil-shale lease tract C-a to the Anvil Points mine with funds provided by the U.S. Bureau of Land Management.

The Geological Survey assumed, as part of an interagency agreement between the USGS and the DOE, assumed responsibility for the core collection including sampling and inspection of the stored oil-shale materials. The Department of Energy assumed responsibility for the maintenance of the mine and road leading to the mine. These and other conditions are included in a memorandum of understanding between the two agencies dated May 31, 1996, which is appended to this report.

Introduction

In the early 1990's the acquisition of a large collection of well cuttings from industry, the establishment of a cold storage facility for polar ice cores and a significant reduction in funding for the U.S. Geological Survey's Core Research Center (CRC) resulted in a reduction of space available for storage of oil-shale core materials by the USGS. It became apparent that the collection of oil-shale materials would need to be reduced by a substantial amount, either by discarding cores or by finding a new site for a large part of the collection.

In August, 1993, the U.S. Geological Survey asked the Director, Naval Petroleum and Oil Shale Reserves in Colorado, Utah and Wyoming (NPOSR), Department of Energy (DOE), Casper, Wyoming, if the Anvil Points experimental oil-shale mine near Rifle, Colorado (fig. 1) could be made available for long-term storage of oil-shale drill cores (Dyni, 1993). The response was favorable. A study of the physical condition of the mine and associated costs to renovate a portion of the mine and to move the cores and

crushed samples from Lakewood, Colorado, to the mine was initiated by John R. Dyni of the USGS and Daniel J. Newquist with the NPOSR.

Mine inspections. The mine was inspected by Newquist, Edward Cooley, former plant manager of the New Paraho Corporation, and John Dyni in November 1993. The inspection confirmed that an area within the mine appeared to be satisfactory for core storage (fig. 2). The proposed area appeared to be dry and was off the main haulage corridor which would avoid conflicts with future mining. The mine roof in the proposed storage area was bolted and showed no obvious evidence of roof sags or falls, although some small fragments of oil shale that probably fell from the mine roof or pillars were noted on the floor. Several piles of oil-shale rubble from previous mining, totaling an estimated 3,250 cubic yards, would need to be moved from the proposed storage area into adjacent rooms. The mine area selected for core storage was estimated to contain 22,750 square feet of floor area within which as many as 1,000 pallets of cores could be placed.

In April, 1995, Mr. Jeff Magers, mining engineer from the Denver Research Center, U.S. Bureau of Mines, inspected the mine with Newquist and Dyni. Magers suggested that convergence points established in the mine roof and floor during earlier mining should be checked for roof sag. This work was not done because of the cost. However, it would be desirable to do so to insure future access to the oil-shale cores and safety of personnel in the area. Magers also suggested that one room on the north side of the core-storage area (north of pillars A and D on figure 2) not be used for storing cores because of its wide expanse. This room was omitted from the final plan.

On the basis of the above inspections, it was determined that the principal advantages of using the mine for storing the oil shale cores included: 1) a dry storage facility where the drill cores would not be subject to deterioration from water or moisture, 2) a safe mine without undue hazards of roof falls, 3) adequate ventilation, 4) minimum maintenance, 5) adequate safeguards from vandalism including a locked gate on the lower mine road and locked doors at the mine portals, and 6) a long-term core-storage site at minimum cost to the USGS and the DOE.

The Anvil Points mine, however, posed some disadvantages, including 1) long distance from the USGS Core Research Center and its core examination facilities, 2) possible closure of the mine road due to earth slides and winter snows, 3) isolated location with no on-site facilities for examination of drill cores, 4) inadequate lighting, 5) limited access to the cores by the public and the necessity to provide personnel for inspection of cores by the public,

and 6) the probability of large quantities of dust settling on and contaminating the cores if oil shale is mined in the future.

Despite the disadvantages, no better location for the oil-shale cores was found and Anvil Points mine remained the best option for long-term core storage. Other options included the rental of storage sheds or buildings, but were deemed to be too expensive for long-term storage. The remaining alternative was to discard the cores and crushed samples, but this option was unacceptable because these materials were thought to be too valuable for present and future research to destroy them. Also, the replacement cost of drilling, sampling, and analyzing these cores was conservatively estimated at $27.7 million. Furthermore, the NPOSR office has an interest in preserving the large number of drill cores from the Naval Oil Shale Reserve lands in Colorado and Utah which are a part of this collection.

Project History

John Dyni submitted an initial inquiry to the NPOSR office in Casper on August 26, 1993, suggesting a cooperative project between the USGS and the DOE to move about 170,000 lineal feet of oil shale drill cores to the Anvil Points mine (Dyni, 1993). The response was favorable so Dyni (1993b) prepared a proposal outling the tasks which included (a) clean up of a portion of the mine where the cores would be stored, (b) preparation & shipping of about 600 pallets of drill core to a staging area near the mine, (c) moving the pallets from the staging area into the mine, and (d) shipment of about 400 tons of oil-shale materials from a DOE storage facility in Laramie, Wyoming, to the mine. The last task (to move oil-shale materials from Laramie to the mine) was subsequently cancelled by DOE.

In July 1995, the CRC announced that about 57,000 square feet of space, in large part occupied by oil-shale cores, needed to be vacated by September 30, 1995. Project work began during July 1995 when Dyni and Donnell made an assessment of which cores at CRC should be sent to Anvil Points mine, those that would be retained at the CRC, and those that were declared surplus to USGS needs and could be discarded. Agreement was reached between DOE and USGS on the statement of the project work outlined below:

Task 1: USGS to load cores and crushed samples of oil shale at the CRC on pallets, identify each pallet, and wrap them in plastic sheeting for long-term storage.

Task 2: Contractor to move piles of oil shale rubble from core-storage area into another part of the mine and clean the floor of the storage area.

Task 3: Trucking company to deliver approximately 600 pallets of cores and crushed samples from CRC to a staging area at the foot of Roan Cliffs below the Anvil Points mine.

Task 4: Contractor to move the cores and crushed samples from the staging area into the core-storage area in the Anvil Points mine in order by state and USGS core hole number.

Task 5: Preparation of a report on the above work by the Geological Survey including tables and maps showing the identification and location of the cores and crushed samples stored in the mine.

In September 1995, New Paraho Corporation moved the muck piles and cleaned the mine floor in the core-storage area. During the month, Colorado All State Transport moved about 600 pallets of oil-shale drill cores and crushed oil-shale samples by flat-bed truck from the CRC to the staging area near the Anvil Points mine. New Paraho Corp. moved the pallets from the staging area into the mine. During this time, with the agreement of the NPOSR office, arrangements were also made between the U.S. Bureau of Land Management (BLM) and the USGS to move about 70 pallets of oil-shale drill cores from Federal oil-shale lease tract C-a to the Anvil Points mine. The BLM paid for this work.

Upon the completion of the project, a Memorandum of Understanding (MOU) between the two agencies concerning the responsibilities and management of the cores and storage facility at the Anvil Points mine was prepared and signed in April 1996 (Turner, 1996). A copy of the MOU is appended to this report.

Project Tasks and Final Costs

The project tasks as completed and final costs for each task are listed in the following table:

Table 1.—Summary of project work by task and final costs.

Task 1. Prepare cores for shipping by placing them on pallets and labeling and wrapping them in plastic sheeting (USGS)	$13,300
Task 2. Operator with loader to prepare area in mine for core storage including moving several piles of oil shale rubble and floor clean-up (New Paraho Corp.)	4,760
Task 3. Move 605 pallets of core on 28 flat-bed truck trips from CRC, Lakewood, Colorado, to the staging area at the base of the mine road (Colorado All State Transport)	11,060
Task 4. (a) Rental of 2 forklifts, electric generator, truck and trailer; fuel; and contract labor for mine clean-up and moving core from the staging area into the mine	

(New Paraho Corp.)	25,838
(b) Planning, coordination, and supervision of project including travel (USGS)	7,000
Task 5. Preparation of a final report with maps and tables showing what cores were moved and their locations in the the Anvil Points mine (USGS).....	2,000
Task 6. Removal of 56 pallets of cores from a wet area to a dry location in the mine (New Paraho Corp.)	1,200
Subtotal	65,158
USGS assessment (21%)	13,683
Grand total	$78,841

Task 6 was added to the original tasks when it was determined that some pallets of core on the north side of pillar F were damp, probably from water draining down the ventilation raise on the north side of the pillar (fig. 2).

The DOE was assessed $35,000 and the remainder of the costs were charged to the USGS. An additional cost to move the 70 pallets of oil-shale cores from the C-a tract to the Anvil Points mine (about $1,500) was paid by the U.S. Bureau of Land Management. This cost is not shown in the above summary.

ANVIL POINTS MINE

Location and mine road. The Anvil Points oil-shale mine is located about nine miles west of the town of Rifle, Colorado near the top of the southward-facing Roan Cliffs at an elevation of about 8,200 feet, or about 3,000 feet above Interstate Highway 70 in the Colorado River valley (fig. 1). The mine road is reached by an asphalt road that begins at the service road south of Interstate 70 and extends northwestward 1.3 miles to the New Paraho oil-shale plant and office.

From the New Paraho facility, a graded dirt and gravel road extends about 5.4 miles up a steep (10-14 percent) grade via six sharp switchbacks to the mine (figs. 1,3, and 4). Nearer the mine, the road is cut into shaly talus that is susceptible to sliding. In places steel cribbing has been installed to stabilize the talus slopes. Some of the steel crib beams are strongly bent indicating downslope movement of loose talus behind the cribs. If the cribbing should fail, the mine road could be blocked and substantial repairs could be required to reopen the road.

Mine development. The Anvil Points mine is in the Mahogany oil-shale zone of the Eocene Green River Formation. The Mahogany zone is a unit of high-grade oil shale, at this location about 100 feet thick (East and Gardner, 1964, fig. 4A). The first of two parts of the mine, named the selective mine, was opened in the late 1940's by the U.S. Bureau of Mines as an experimental facility followed by the demonstration mine about 1,500 feet west of the haulage-way of the first mine. Later, the demonstration mine and retorting facilities were operated by several groups prior to their decommissioning in 1984-85 (Virgona, 1986). Most recently, some of the crushed oil-shale from earlier mining was removed by New Paraho Corporation in the the late 1980's to make several thousand barrels of an asphalt additive for road paving in its retort and plant at the base of Roan Cliffs (fig. 1). New Paraho has been negotiating with DOE to mine additional oil shale from the Anvil Points mine in the future.

Oil shale in the Anvil Points mine was mined by the U.S. Bureau of Mines in two levels consisting of a top heading 39 feet in height and a lower bench 34 feet high. The core-storage area is in the top heading. The oil shale in the top heading averages about 28 gallons of shale oil per ton of rock. The Mahogany marker, a prominent layer of analcimized tuff 4-6 inches thick occurs in about the middle of the upper heading (East and Gardner, 1964, fig. 24).

Roof conditions. The mine roof which forms a smooth surface is rock-bolted throughout the mine. Inspection bore holes ranging from 7 to 15 feet in length were drilled into the roof adjacent to, and in, the core-storage area. A borescope inspection of these holes revealed two, probably continuous, bedding-parallel fractures in the lower 2 feet of the roof rock with a few fractures above (East and Gardner, 1964, fig. 35).

Roof falls. On the south side of the mine near the natural outcrop of oil shale, several roof falls occurred in 1953 and 1955 when the mine was operated by the Bureau of Mines (fig. 2; East and Gardner, 1964, p. 136-142). There have been no major roof falls since that time, although small fragments of oil shale have loosened from the ribs and roof and have fallen to the floor in some parts of the mine.

Damp area. An area of the mine floor in the proposed core storage area in the vicinity of pillar F was noted to have been damp after the project was begun, although the floor was dry at the time of the initial inspections. The water was thought to be from seepage from the ventilation raise on the north side of pillar F that opens to the surface on the top of Roan Cliffs (fig. 3A).

Ventilation. Several adits and the ventilation raise provide adequate ventilation to the mine for short visits. However, operation of diesel-powered machinery would require additional ventilation in the mine. The mine has been operated as a methane-free mine in the past. Presumably, methane is not a hazard in this mine because it is close enough to the natural outcrop to have degassed through open fractures. However, other oil-shale mines in the northern and deeper part of the basin are gassy.

CORE STORAGE AREA

An area occupying about 22,750 square feet of floor space was selected for storage of the oil-shale materials in the central part of the demonstration mine (fig. 2). This area was selected because it appeared to be essentially dry with the exception noted above, and was roof-bolted with no obvious signs of structural weakness in either the roof strata or pillars. The final configuration of the storage area, after 56 pallets of drill cores near pillar F were relocated away from the damp area north of the pillar, is shown on figure 5.

An attempt was made to sort the pallets by states and USGS core hole number[1]. The Wyoming cores are located east of pillar A (fig. 6). The Colorado cores and crushed samples are located north and east of pillars B and C (fig. 7), on the west and south sides of pillar D (fig. 8), on the north, west, and south sides of pillar E (fig. 9), and on the west side of pillar F (fig. 10). The Utah cores are located west of pillar D (fig. 8).

SELECTION OF DRILL CORES AND CRUSHED SAMPLES

In early 1993, about 173,000 lineal feet of oil-shale drill cores were stored at the USGS Core Research Center at the Denver Federal Center, Lakewood, Colorado. Of this total, about 3,915 feet of drill cores from 22 core holes were deemed to have little or no value for permanent retention. Therefore, these drill cores were discarded. The basis of selecting these cores for disposal included short cored sequences; usually of the Mahogany oil-shale zone); proximity to nearby cores that penetrated thicker sequences of oil shale; incomplete or jumbled cores with missing sequences; lack of geophysical logs and shale-oil analyses,

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[1]All of the drill cores are identified by a 3-digit number preceeded by 'C' for Colorado, 'U' for Utah, 'W' for Wyoming, 'E' for eastern United States, and 'F' for foreign drill cores. These numbers are those used earlier on maps published by USGS oil-shale geologists, and are different than those used for archival purposes by the USGS Core Research Center. Also, some of the Tosco cores are identified by numbers similar to, but are not the same as, those used in this report.

and cores from closely spaced development holes drilled on Federal oil shale tracts. These discarded cores are listed in table 2.

Table 2.—List of oil-shale drill cores at the USGS Core Research Center that were discarded.

USGS No.	CRC No.	Company and well	Location	Lineal feet
		Colorado		
C038	U511	Ertl, Atlas	SW-NE-11-04S-095W	138
C040	U508	Ertl, Lathum	SW-NW-06-04S-095W	147
C082	U514	Tosco,Bute 25	SE-NE-09-04S-096W	249
C141	U537	Savage, Carr(Linden)	NE-NW-17-05S-099W	404
C203	U569	Tosco, TG 71-3	NE-NW-29-03S-096W	288
C205	U570	Tosco, TG 71-5	NE-NE-33-03S-096W	304
C219	U564	Tosco, Cb-2	NE-SE-06-03S-096W	202
C296	U523	Savage, Avery	NE-SW-23-04S-096W	454
C297	U520	Savage, Love	SW-SW-19-04S-098W	500
C341	?	USGS, 78-6	NE-NE-11-02S-099W	171
C456	U522	Tosco, Ohio 6	SW-NE-21-04S-098W	201
C465	U510	Tosco, Atlas 14	SW-SW-10-04S-095W	205
			Subtotal	3,263
		Utah		
U402	---	Geokinetics 32-1	SW-SW-34-09S-21E	60
U405	U615	Geokinetics 1	NW-NW-02-14S-22E	60
U411	U616	Geokinetics 7	SE-SW-02-14S-22E	60
U410	U617	Geokinetics 6	NE-SW-02-14S-22E	60
U409	U618	Geokinetics 5	SE-NW-02-14S-22E	60
U408	U619	Geokinetics 4	NW-NE-02-14S-22E	60
U407	U620	Geokinetics 3	SW-SW-02-14S-22E	112
U406	U621	Geokinetics 2	SW-NW-02-14S-22E	60
U482	U623	Geokinetics16-22U	NW-NE-02-14S-22E	60
---	U624	Geokinetics, ?	?	60
			Subtotal	652
			Total	3,915

Of the total of about 600 pallets of cores and crushed oil-shale samples that were moved from the CRC to the Anvil Points mine, about 475 pallets were cores and about 125 pallets were crushed samples. The cores are listed in table 3. A few pallets were not labeled, either because the core boxes were not clearly identified or for other reasons. Careful examination of the core boxes and/or other

logistical data in the future may reveal their identity, therefore, they were saved and are stored in the mine.

Table 3.—Oil-shale drill cores stored in the Anvil Points mine.

USGS No.	Company and core hole	Location	Cored depths	No. of pallets
		Colorado drill cores		
C002	Wolf Ridge, Dunn 20-1	NE-NE-20-01S-098W	1501-2413	?
C003	Sinclair, Federal 8024	C-20-01N-098W	1148-1984	1
C006	Sinclair, Fed. Strat 1 & 1B	SW-SW-06-01S-097W	833-2592	1
C007	Pan Am, Saterdal 1	NW-SE-31-01S-097W	770-2745	1
C008	Sinclair, Skyline 1	NW-NE-26-01S-098W	389-3049	5
C013	Sinclair, Skyline 2	NE-NE-11-02S-098W	711-2547	?
C014	Sinclair, Bradshaw 1	C-NE-25-02S-098W	403-2051	4
C015	Humble, Milo Love 1	SW-SW-09-02S-097W	584-1995	2
C018	Tel Ertl, core hole Phil	NE-SE-25-01S-100W	10-206	1
C023	Weber, GJ-1	NE-SW-23-02S-100W	21-290	?
C034	USBM/AEC, Colorado 1	NE-NE-13-01N-098W	770-3133	4
C035	USBM/AEC, Colorado 2	NW-NE-14-01S-099W	805-2409	8
C050	Unocal, Buff	NW-SE-23-04S-096W	10-812	1
C060	Weber, Figure Four 2	SW-NW-15-04S-099W	30-375	1
C072	U.S. Navy, core hole F (NOSR 1)	SE-SE-06-05S-094W	10-776	1
C109	Pacific Oil, Allen 1	NE-NW-34-06S-097W	8-770	1
C125	Savage, Whiskey	NE-NE-24-04S-098W	31-623	1
C126	Savage, Camp	SW-SE-35-04S-098W	33-865	2
C130	USN/USBM, Corehole H	SE-SW-23-05S-095W	24-843	2
C140	Skyline, Hydrocarbon 1	NE-NW-17-05S-099W	155-485	1
C144	Skyline, Hydrocarbon 2	SE-NW-13-05S-100W	70-568	1
C148	Mobil, BOM D (CH 4)	NE-NW-18-06S-095W	180-855	2
C152	Tosco, TG-1 & 1-A	SW-SE-24-02S-099W	1120-2123	4
C157	Carter, Yellow Creek 1	NE-NE-02-01S-098W	637-2245	10
C161	General Petrol., 11-24	NW-NW-24-02S-096W	1719-2727	?
C171	USBM/AEC, Colorado 3	SW-SW-14-01N-098W	964-3326	1
C173	USBM, Barcus Creek 1	NW-NE-21-01N-099W	10-1800	4
C175	Arco, Federal 2-B	NW-SE-10-03S-096W	1084-3100	2
C176	Tosco, TG 2-1	NE-SW-21-03S-096W	313-2247	3
C177	Shell, 22X-1	SW-NE-01-02S-098W	680-2649	1
C189	Superior, Core hole 5	NE-NW-10-01N-097W	200-1368	4
C190	Superior, Core hole 6	SE-SW-14-01N-097W	70-1393	4
C193	Tosco, Bute 14-727	NW-NW-14-04S-096W	12-932	1
C194	Tosco, Camp Bird 5	NE-NW-03-04S-095W	13-1475	3
C195	Arco et al, Fig. Four 31-1	SW-NE-31-03S-098W	538-2420	7
C197	Shell, 41X-9	NE-NE-09-01S-097W	1300-2748	1
C200	Mintech, Portland 1	SW-SE-19-01S-099W	26-1342*	3
C202	Tosco, TG 71-2	NE-NE-17-03S-096W	801-1158	?
C204	Tosco, TG-71-4	NW-SW-06-04S-096W	700-2018	2
C206	Cameron Engrs, CE-701	NW-NE-32-01S-099W	150-1118	6
C207	Cameron Engrs, CE-705A	SE-NE-04-02S-099W	175-1550	4
C209	Superior, Core hole 12	SE-SW-27-01N-097W	905-2605	1
C213	Cameron Engrs, CE-708	NE-NE-05-02S-099W	115-1219	7
C214	Cameron Engrs, CE-707	SE-SE-32-01S-099W	83-1515	5
C215	Cameron Engrs, CE-702	SE-NE-34-01S-099W	400-1713	9
C218	Tosco, Cb-1	SW-SW-01-03S-097W	1280-2104	1
C220	Tosco, Cb-3	SW-SE-05-03S-096W	1240-2122	?
C221	Tosco, Cb-4	NW-SW-17-03S-096W	1280-1490	1
C231	Humble, Jumps Cabin 1	SW-SW-15-04S-098W	275-1124	12
C232	Humble, East Willow Cr. 1	NW-NE-28-04S-097W	200-1950	5
C236	Tosco, Ca-3	SE-NE-34-01S-099W	450-1561	1
C238	Tosco, Ca-2	NW-NE-32-01S-099W	180-1130	4
C246	Superior Oil, CH 28	SE-SW-15-01N-097W	90-2025	1
C247	Superior Oil, CH 29	SW-SE-21-01N-097W	946-2378	4

C248	Carter, Fawn Creek 2	NE-NW-27-03S-098W	386-2161	10
C261	C-a Project, C-1	NW-SW-32-01S-099W	44-1401	6
C262	Gulf/Standard Indiana, CH 2-3	SW-NW-33-01S-099W	46-1424	5
C263	Gulf/Standard Indiana, CH 4-5	SE-NW-34-01S-099W	48-1663	7
C264	Gulf/Standard Indiana, CH 6	SE-SE-34-01S-099W	157-1782	1
C265	Gulf/Standard Indiana, CH 7	SE-NW-05-02S-099W	41-1200	2
C266	Rio Blanco Oil Shale, CH-8	SE-SE-05-02S-099W	70-1616	5
C267	Rio Blanco Oil Shale, CH-9	SE-NW-04-02S-099W	44-1600	4
C268	Rio Blanco Oil Shale, CH-10	NW-SE-03-02S-099W	352-1903	7
C269	Rio Blanco Oil Shale, CH-11	SW-SW-09-02S-099W	390-1886	7
C270	Rio Blanco Oil Shale, CH-12	NE-SW-09-02S-099W	41-1800	7
C291	USGS, CR-2 (WRD TH 75-17B)	SE-NE-36-01N-097W	507-2409	4
C292	Carter, Upper Piceance Creek 1	SE-SW-12-03S-096W	300-2208	8
C299	USBM, CH 02-A	NW-SW-29-01S-097W	198-2660	17
C301	Arco et al, Fig. Four 01-1	SE-NW-01-04S-099W	490-681	1
C306	Carter, Upper Willow 2 & 2-A	NW-NE-27-03S-097W	260-2241	7
C331	USBM, CH-01	SW-SE-31-01S-097W	750-2383	10
C334	USBM, CH 01-A	NW-SW-29-01S-097W	830-2548	13
C338	USGS, 78-1A	NE-SE-06-04S-094W	32-100	?
C339	USGS, 78-2	SE-NW-24-03S-095W	33-307	1
C340	USGS, 78-3A	SW-SW-26-02S-095W	6-302	1
C344	USGS, 78-9	NW-SW-29-02N-099W	15-205	1
C347	USGS, 78-8	NW-NE-22-01N-100W	20-630	2
C348	USGS, 78-12	SE-SE-07-05S-101W	20-330	1
C350	U.S. Navy, CH 15/16	NW-SW-01-05S-095W	122-2060	11
C352	Sinclair, Cross V No.1	NW-NE-21-01S-098W	850-2816	4
C353	U.S. Navy, CH 21 (NOSR 1)	SE-SE-19-05S-094W	645-1655	6
C354	U.S. Navy, CH 26 (NOSR 1)	NW-SE-36-05S-095W	605-1087	3
C355	USGS, 78-10	NE-SW-11-03S-100W	27-299	1
C357	USGS, 78-11	SW-SE-07-04S-100W	20-202	1
C358	USGS, 78-5	SE-NW-32-02N-097W	6-323	1
C359	U.S. Navy, CH 25 (NOSR 1)	SE-NE-34-05S-094W	130-840	4
C360	U.S. Navy, CH 20 (NOSR 1)	SW-SW-14-05S-095W	630-1920	5
C361	U.S. Navy, CH 17 (NOSR 1)	SW-NE-08-05S-094W	790-1880	6
C362	U.S. Navy, CH 22 (NOSR 1)	SE-SW-21-05S-094W	650-1547	5
C363	U.S. Navy, CH 18 (NOSR 1)	NE-NE-13-05S-095W	46-1257	7
C364	U.S. Navy, CH 19-2/4 (NOSR 1)	SW-NW-03-05S-094W	116-798	2
C365	U.S. Navy, CH 24 (NOSR 1)	SW-SE-32-05S-094W	92-937	1
C422	Union, LR 4-75	SW-NE-20-05S-095W	649-1802	3
C451	Tosco, TG-2-3	SW-SW-23-03S-096W	20-636	1
C457	Tosco, Liberty Bell 12	SE-SE-18-04S-095W	545-743	1
C462	Tosco, Bute 11	SE-SW-12-04S-096W	21-893	3
C476	Savage, Quinn	SW-NE-35-04S-098W	7-243	1
C522	D.T. Day, DTD 28-1	SE-SW-36-01N-100W	20-300	1
C526	Humble, Milo Love 2	SW-SW-09-02S-097W	584-1995	4
C543R	Cameron Engrs, CE 703	SW-NW-05-02S-099W	0-1345	6
C544R	Cameron Engrs, CE 704C	NE-SW-16-01S-099W	0-1950	4
C552R	El Paso, Fawn Creek 2	NW-NW-17-03S-097W	0-3300	1
C707	Sinclair, Haystack 11-1	SW-NE-11-07S-097W	510-611	1
C711	Tosco, Ohio 3	NE-NE-23-04S-098W	441-570	1
C764	Sinclair, Haystack 1-1	SE-NW-01-07S-097W	19-591	3
C765	Sinclair, Haystack 26-1	SW-NE-26-06S-097W	469-540	1
C849	Arco et al, Fig. Four 11-1	SE-NW-11-04S-099W	600-763	1
C854	Arco et al, Fig. Four 9-1	SW-NE-09-04S-099W	100-313	1
C856	Arco et al, Fig. Four 15-1	SW-NE-15-04S-099W	546-718	1
C864	Arco et al, Fig. Four 24-1	NE-SW-24-04S-099W	719-840	1
C872	Sinclair, Haystack Mtn. 1	NE-SW-31-06S-096W	0-290	1
C874	Arco et al, Fig. Four 5-1	NE-SW-05-04S-099W	303-434	<1
C875	Arco et al, Fig. Four 7-1	NE-SW-07-04S-099W	86-234	1
—	Exxon, Milo Love 3	?		2
—	Exxon, Core hole 3	?	?	2
—	Tosco?, Colony 1-2	?	?	1

Utah drill cores

U003	USGS, CH-3 (NOSR 2)	NW-SW-01-12S-19E	385-557	?
U015	USGS, CH-15 (NOSR 2)	NE-SW-26-12S-18E	30-170	?
U041	Brewer et al, 8-1	NW-SW-08-13S-24E	0-277	1
U043	Western Oil Shale, EX-1	SW-SE-36-09S-20E	190-1911*	1
U055	USGS, CRU-1	NE-NE-03-12S-24E	14-498	2
U056	White River Shale Project, P-1	SE-SW-12-10S-24E	68-1240	1
U057	White River Shale Project, P-2	SE-SE-17-10S-24E	94-1292	1
U058	White River Shale Project, P-3	SE-SW-26-10S-24E	70-1220	7
U059	White River Shale Project, P-4	NE-SE-19-10S-25E	52-1173	6
U060	White River Shale Project, X-1	NE-SE-30-10S-24E	870-1140	2
U061	White River Shale Project, X-2	NE-NW-14-10S-24E	460-766	2
U062	White River Shale Project, X-3	NE-NW-18-10S-25E	321-591	2
U063	White River Shale Project, X-4	SW-SW-14-10S-24E	660-958	2
U064	White River Shale Project, X-5	SE-NE-23-10S-24E	670-936	2
U065	White River Shale Project, X-6	NW-NW-19-10S-25E	510-805	2
U066	White River Shale Project, X-9	SE-NW-27-10S-24E	816-1068	2
U067	White River Shale Project, X-10	NW-NE-33-10S-24E	840-1098	2
U068	White River Shale Project, X-11	NW-NE-28-10S-24E	691-1023	2
U069	ERDA-LERC, So. Uinta Basin 1	NE-NE-30-12S-21E	20-347	1
U070	ERDA-LERC, So. Uinta Basin 2	SW-NE-35-12S-21E	19-327	1
U071	ERDA-LERC, So. Uinta Basin 3	NW-NW-17-13S-22E	19-350	1
U072	ERDA-LERC, So. Uinta Basin 4	SW-NE-35-13S-22E	12-217	1
U073	ERDA-LERC, So. Uinta Basin 5	SW-SE-35-13S-22E	1-137	1
U074	ERDA-LERC, So. Uinta Basin 6	NE-NE-31-13S-22E	1-236	1
U077	ERDA-LERC, So. Uinta Basin 9	SW-NE-06-13S-24E	35-276	1
U078	ERDA-LERC, So. Uinta Basin 10	SE-NW-10-13S-24E	5-232	1
U079	ERDA-LERC, So. Uinta Basin 11	SW-NE-10-13S-22E	159-581	1
U080	ERDA-LERC, So. Uinta Basin 12	NW-SE-19-12S-24E	91-621	1
U086	USGS, Asphait Wash 1	SW-NE-07-11S-24E	307-2088	3
U090	Arco, Long Draw 1 (UT 337)	NE-SE-36-12S-24E	20-216	1
U100	USGS, WR-7	SW-NW-12-15S-21E	20-98	?
U101	Tosco, Utah State 11-18	NW-NW-18-10S-22E	1535-1871	1
U102	Tosco, Utah State 1	NE-NE-26-09W-21E	1570-2600	7
U104	Tosco, Utah State 41X-16	NE-NE-16-10S-22E	1821-2078	2
U105	Tosco, Utah State 23-36	NE-SW-36-10S-22E	1183-1483	1
U106	Tosco, Utah State 42X-36	SE-NE-36-09S-22E	1749-2054	1
U108	Shell, 14-36	SW-SW-36-09S-21E	1850-2508*	4
U109	DOE-LETC, Cowboy Canyon 2	NE-NW-33-09S-25E	391-521	2
U110	Shell, 14X-34	SW-SW-34-09S-21E	1750-2597	3
U111	Shell, 22X-12	SE-NW-12-10S-22E	1500-2156*	3
U112	Tosco, Utah State 13X-2	NW-SW-02-10S-21E	120-2380	8
U114	DOE-LETC, Cowboy Canyon 1	NW-NE-33-09S-25E	440-677	2
U130	WRSP, X-13	SW-SE-22-10S-24E	13-1125	3
U172	ERDA-LERC, Avintiquin Canyon 1	SW-SE-20-05S-08W	42-345	1
U173	ERDA-LERC, Half Moon Canyon 1	NW-SE-12-05S-08W	198-1594	?
U174	ERDA-LERC, Sams Canyon 1	NW-NW-14-04S-07W	43-361	1
U175	Paradox Prod., Argyle Can 200	SE-SE-35-10S-11E	4-866	3
U180	Sinclair (Arco), Henderson 3	SE-NW-16-10S-15E	2200-2562	1
U404	Geokinetics, W-14	NE-NE-02-14S-22E	10-300*	1
U415	Geokinetics, Lofreco CH-6	NE-NE-02-14S-22E	9-38*	1
—	DOE, Cowboy Canyon 3	?	?	10
—	Gulf Oil, West Knobs C-3	?	?	1
—	Gulf Oil, North Knobs C-4	?	?	1
—	White River Special Proj., WC-81-692	?	?	5

Wyoming drill cores

W006	USBM, Wyoming 1	SW-NW-30-23N-107W	375-1275	2
W013	Diamond Alkali, Finley 1	NE-NE-08-16N-110W	2321-2379	4
W051	Sinclair, Federal 1 (6765)	SW-NE-06-15N-108W	460-2000	1
W052	USBM, Washakie 1	NW-SW-17-14N-099W	101-2857	3
W059	USBM, Wyoming 6	SW-NW-25-23N-109W	402-834	1

W061	USBM, Wyoming 3	NW-SW-29-24N-108W	368-799	1
W062	USBM, Wyoming 8	NW-NE-01-23N-110W	355-775	1
W063	USBM, Wyoming 5	NE-SW-03-24N-107W	330-779	1
W065	UPRR, GB-1C	NW-NW-17-15N-107W	55-311	1
W066	UPRR, GB-2C	SE-NW-27-15N-107W	16-280	1
W067	UPRR, GB-3C	NW-SE-09-17N-106W	22-233	1
W068	UPRR, GB-4C	SE-SW-03-17N-106W	19-185	1
W069	UPRR, GB-5C	SE-NW-35-20N-105W	21-307	1
W070	UPRR, WB-1C	SE-SE-03-16N-100W	20-393	1
W071	UPRR, WB-2C	SE-NE-05-16N-099W	200-545	1
W072	UPRR, WB-3C	SE-NW-31-17N-098W	120-513	1
W073	UPRR, WB-4C	SW-NW-23-16N-100W	160-521	2
W074	UPRR, WB-5C	NW-SE-05-15N-100W	140-516	2
W075	UPRR, WB-6C	SW-NW-23-15N-100W	120-623	3
W076	UPRR, WB-7C	SE-NE-35-15N-100W	220-728	3
W083	USBM, Washakie Basin 2	SW-SW-06-14N-098W	2396-3236	2
W086	DOE/LERC, Greens Canyon 1	SE-NE-20-19N-106W	140-230	1
W096	USBM, Wyoming 9	SE-NE-24-22N-109W	545-987	1
W097	USBM, Wyoming 10	SW-SE-04-24N-109W	203-541	1
W098	USBM, Wyoming 7	SE-SE-02-25N-107W	364-689	1
W148	Allied Chemical, AC 2	SE-SW-31-19N-109W	1540-1601	<1
W150	Allied Chemical, AC 4	NE-NW-06-18N-109W	1561-1602	<1
W151	Allied Chemical, AC 5A	NW-NE-05-18N-109W	1505-1676	<1
W153	Allied Chemical, AC 16	NE-SW-20-19N-109W	902-1500	<1
W154	Allied Chemical, AC 29	NE-SW-33-19N-109W	1450-1497	<1
W155	Allied Chemical, AC 30	SW-SE-28-19N-109W	1400-1490	<1
W157	USBM, Washakie Basin 1A	SW-SW-24-14N-100W	210-1184	3
W168	Diamond Alkali, Greene 1	SW-SE-36-19N-108W	385-473	1
W549	WRI, Wyoming 14	SE-NW-33-26N-110W	?	1
W929	LERC, Wyoming 13	NE-NE-06-27N-108W	63-310?	1
W943	LETC, Wyoming 11	SW-SW-31-26N-108W	?	1
W944	LERC, Wyoming 12	NE-NE-35-27N-108W	68-344?	1
—	ARCO, Elm Creek 1	?	?	<1
—	ARCO, Jack Fork Creek 1	?	?	<1

Non-Green River oil-shale drill cores

—	Dow-ERDA, Michigan CH 301	Dev-Miss. Antrim Shale	?	?
E002	Hycrude, Kentucky HC-KY-1	Dev-Miss, New Albany Shale	25-91	?
F004	Sweden, Barstad 85001	Cambrian Alum Shale	?	?
F005	Sweden, Barstad 85002	Cambrian, Alum Shale	?	?
F006	Sweden, Hynneberg BH 85002	Cambrian, Alum Shale	?	?
F008	Tosco, 128-G, Timidhit, Morocco	Cretaceous shale	?	1

Notes:
DOE=U.S. Department of Energy, ERDA=U.S. Energy Research & Development Administration, LERC= Laramie Energy Research Center, LETC=Laramie Energy Technology Center, WRI=Western Research Institute (LERC=LETC=WRI), USBM=U.S. Bureau of Mines, UPRR=Union Pacific Railroad Co., *=estimated cored interval; <1, indicates that the core is one of several cores on one pallet.

An inspection of the mine and the pallets of cores in the storage area was made by Dyni and Newquist on August 26, 1997. Some discrepancies were noted in an earlier list of cores stored in the mine provided by the contractor, therefore, all of the pallets were reexamined and the cores listed in the above table were corrected. However, some cores listed by the contractor could not be found, possibly because several cores were placed on the same pallet. These cores are still included in the table, but the number of pallets is indicated by a query.

DRILL CORES FROM TRACT C-a

Rio Blanco Oil Shale Company, operator of the facilities on Federal Oil-Shale Lease Tract C-a, had in its possession about 11,245 boxes of drill cores from about 44 core holes drilled on, or near, the tract. The drill cores and rotary cuttings were stored in a shed on the lease. The USGS was offered the drill cores by the company and about 5,586 boxes of drill cores from 13 core holes, or about one-half of the

total number of boxes stored on the tract, were selected for permanent storage in the Anvil Points mine. Unfortunately, the core storage building was being dismantled during the time the cores were being moved, and some boxes of the selected drill cores were dumped and lost. Table 4 lists the drill cores that were saved and stored in the Anvil Points mine.

Table 4.—Drill cores from Federal oil shale tract C-a that are stored in the Anvil Points mine (Portions of some cores may be missing).

USGS No.	Company and core hole	Location	No. of boxes
C206	Cameron, CE 701	NW-NE-32-01S-099W	308
C213	Cameron, CD 708	NE-NE-05-02S-099W	316
C214	Cameron, CD 707	SE-SE-32-01S-099W	398
C238	Tosco, Ca-2	NW-NE-32-01S-099W	190
C261	Gulf/Std Ind, C-1	NW-SW-32-01S-099W	522
C262	Gulf/Std Ind, C2-3	SW-NW-33-01S-099W	450
C263	Gulf/Std Ind, C4-5	SW-NW-34-01S-099W	86
C264	Gulf/Std Ind, C-6	SE-SE-34-01S-099W	560
C265	RBOSC, C-7	SE-NW-05-02S-099W	358
C266	RBOSC, C-8	SE-SE-05-02S-099W	533
C267	RBOSC, C-9	SE-NW-04-02S-099W	488
C268	RBOSC, C-10	NW-SE-03-02S-099W	542
C269	RBOSC, C-11	SW-SW-09-02S-099W	548
C270	RBOSC, C-12	NE-SW-09-02S-099W	508

Notes: Cameron=Cameron Engineers, Gulf/Std Ind=Gulf Oil Co. and Standard Oil Co. of Indiana, RBOSC=Rio Blanco Oil Shale Co.

Crushed samples. A large collection of crushed samples from the former DOE Laramie Energy Technology Center (LETC), Laramie, Wyoming were also moved from the CRC to the Anvil Points mine. The samples are raw oil-shale splits of crushed segments of drill cores that were analyzed for shale oil by the Fischer assay method. The samples consist of about 1-1.5 kilograms of material each stored in paper sacks that were placed in 16"x4"x24" cardboard core boxes. These samples came from drill holes drilled between the late 1940's to the mid-1980's. About 122 pallets of these samples are stored between pillars B and C in the Anvil Points core-storage area (fig. 5).

CONCLUSIONS

Reduction in funds and space at the USGS Core Research Center necessitated moving a large amount of crushed samples and drill cores to other sites. Of these, about 600 pallets

of core and crushed samples of oil shale were moved from the USGS Core Research Center in Lakewood, Colorado to the Anvil Ponits mine near Rifle, Colorado and additional 76 pallets of core stored on the C-a oil-shale lease tract were moved to the mine. The total cost of the project was $78,841 of which $35,000 was paid by the DOE and the remainder by the USGS. The work was essentially completed in September 1996.

Although the mine is not the ideal site for storing these cores and crushed samples, it was thought to be better than other alternatives that were considered. The mine is believed to be a satisfactory site for low-cost long-term storage with minimal maintenance required. As funding permits, the USGS is the responsible curator of the core and sample collection and the DOE is responsible for road and mine maintenance as implemented in a Memorandum of Understanding dated May 31, 1996.

REFERENCES

Dyni, J.R., August 26, 1993, Letter to Mr. Ray Williams, U.S. Department of Energy, Casper, Wyoming (copy in Appendix).

East, J.H., Jr., and Gardner, E.D., 1964, Oil-shale mining, Rifle, Colo., 1944-56: U.S. Bur. Mines Bull. 611, 163 p.

Science Applications, 1980, Anvil Points mine. Plan-proposed mine development and utilities [plan view of the demonstration and selective mines], scale: 1:600.

Turner, C.D., May 31, 1996, Letter (Serial No. DJN/041.655) to Mr. Thomas Michalski with enclosed Memorandum of Understanding between the U.S. Department of Energy and the U.S. Geological Survey for Storage of Oil Shale Core at Anvil Points Mine, 6 p. (copy in Appendix).

Virgona, J.E., 1986, Decommissioning of the U.S. Department of Energy Anvil Points oil shale research facility *in* Gary, J.H., [ed.] Nineteenth Oil Shale Symposium Proceedings: Colorado School of Mines Press, Golden, p. 161-176.

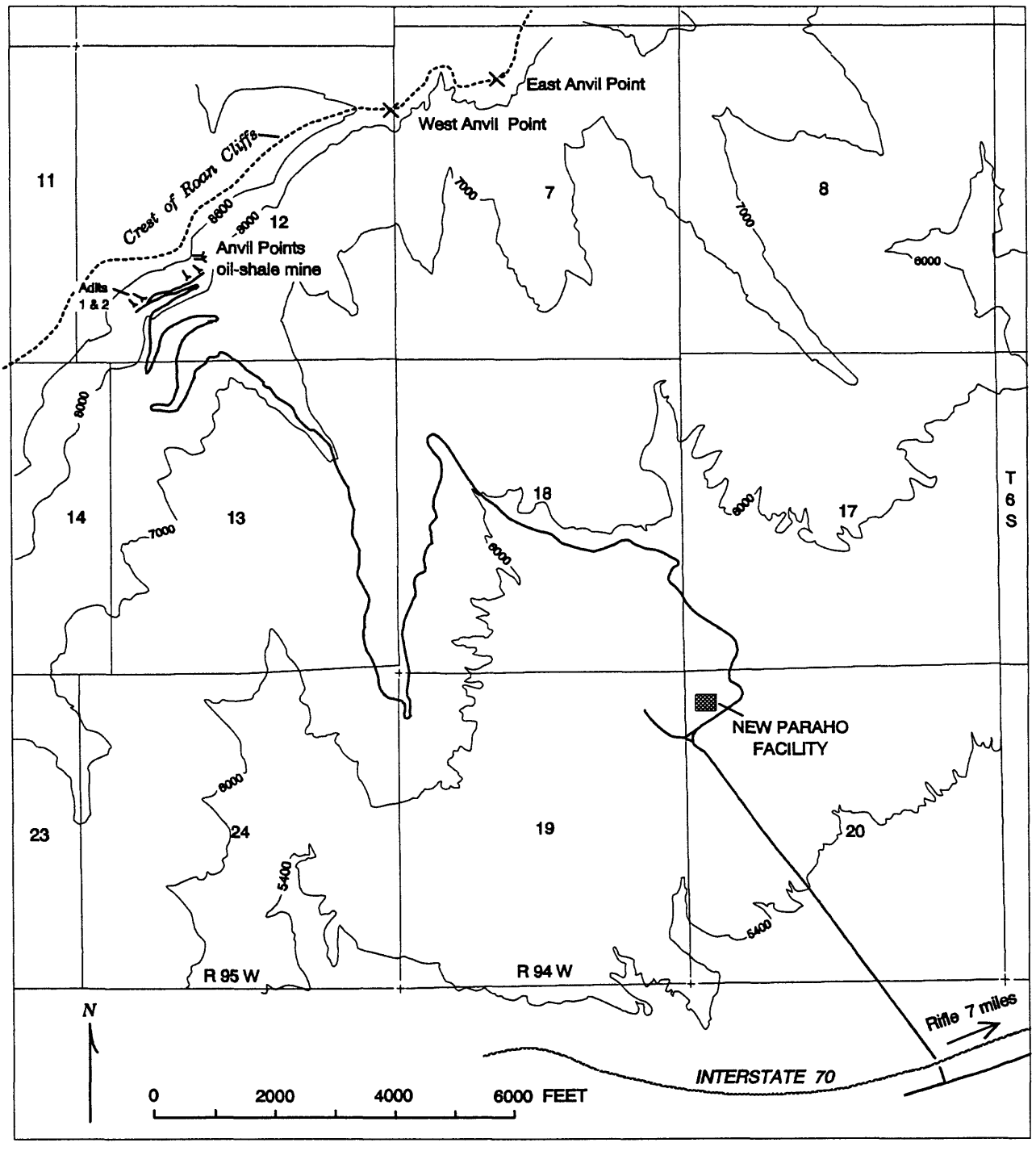

Figure 1. Map showing the location of the Anvil Points oil-shale mine.

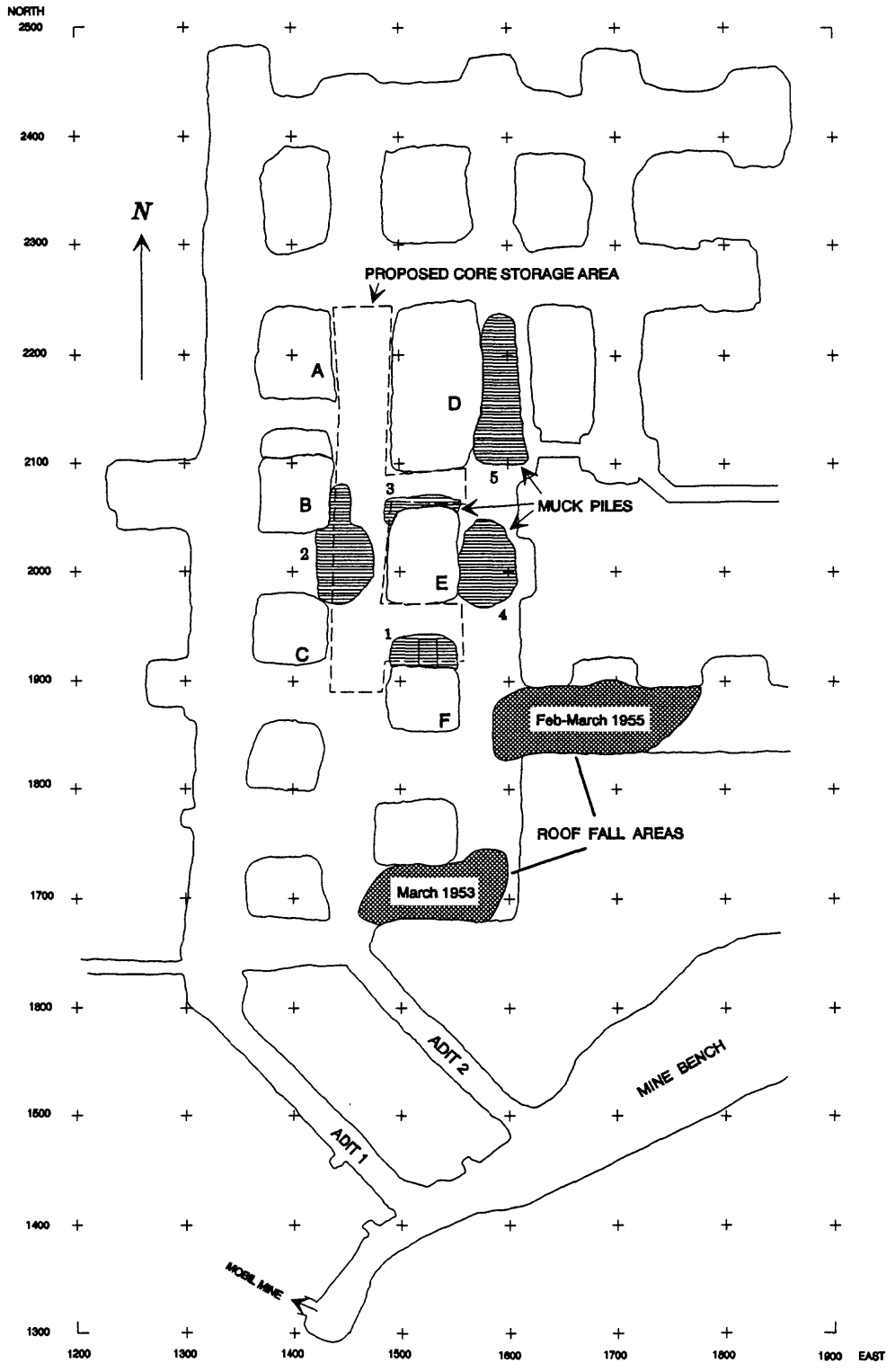

Figure 2.---Plan view of the west side of the Anvil Points demonstration mine. The mine bench at the portal of adit 2 is at an elevation of 8189 feet (East and Gardner, 1964, fig. 12). The plan view of the mine and the survey coordinates are from Science Applications, Inc. (1980).

A

B

Figure 3. A, View of Roan Cliffs from near Interstate Highway I-70. The road to Anvil Points mine can be seen to the left of center of the photograph. B, View of the cribbing along the upper part of the mine road. Note the contorted beams.

A

B

Figure 4.—A, View of the Mahogany oil-shale ledge at the level of the Anvil Points mine. Adit No. 2 can be seen to the left of center in the photograph. B, Adit Number 1 to the demonstration mine. The steel door to the mine (not visable) is in about 100 feet from the portal.

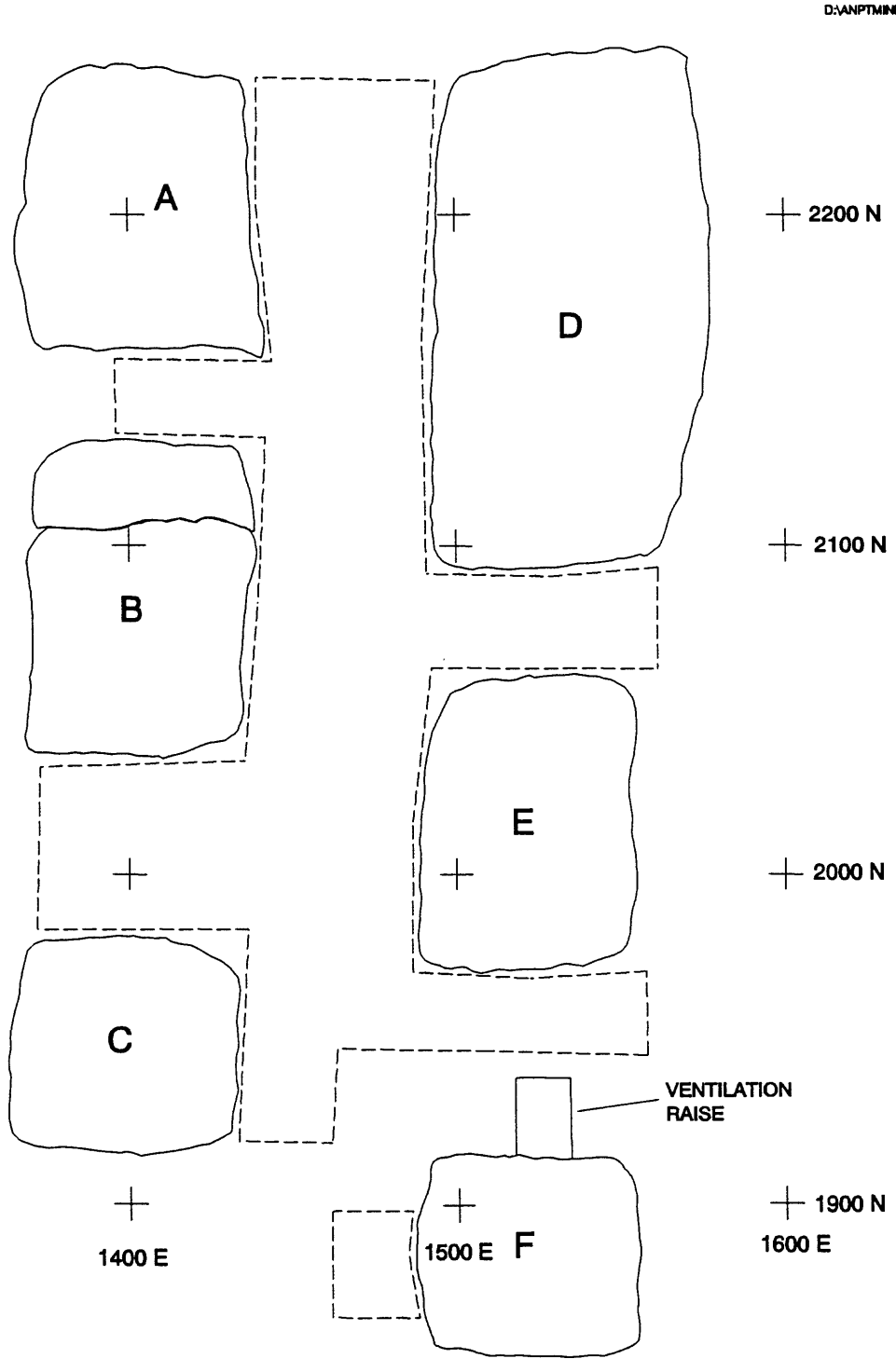

Figure 5.---Plan view of the final core-storage area in the Anvil Points mine.

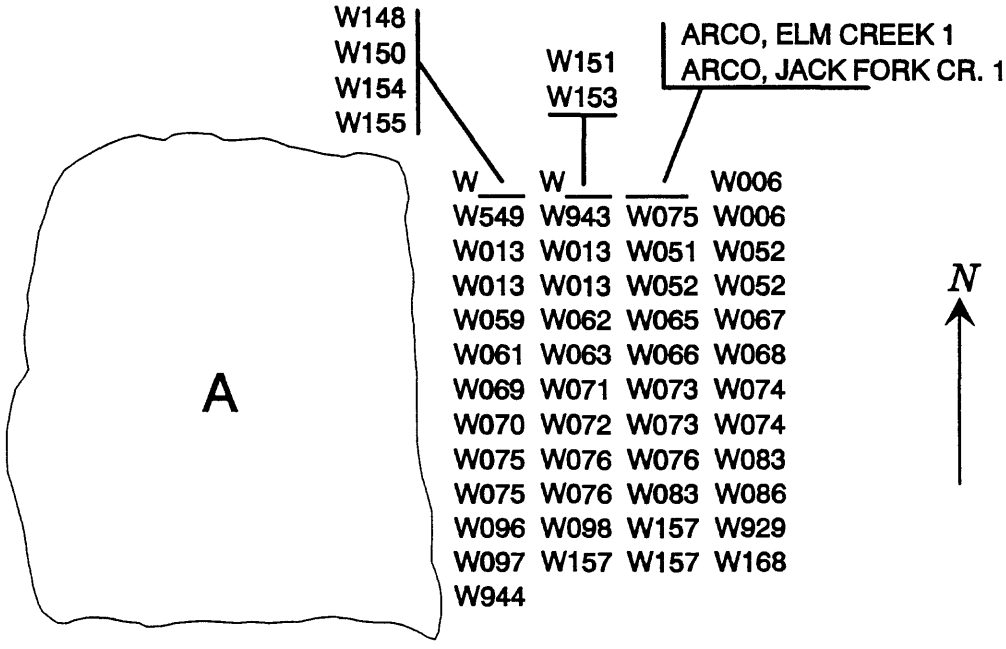

Figure 6.---Identification of pallets of drill cores east of pillar A.

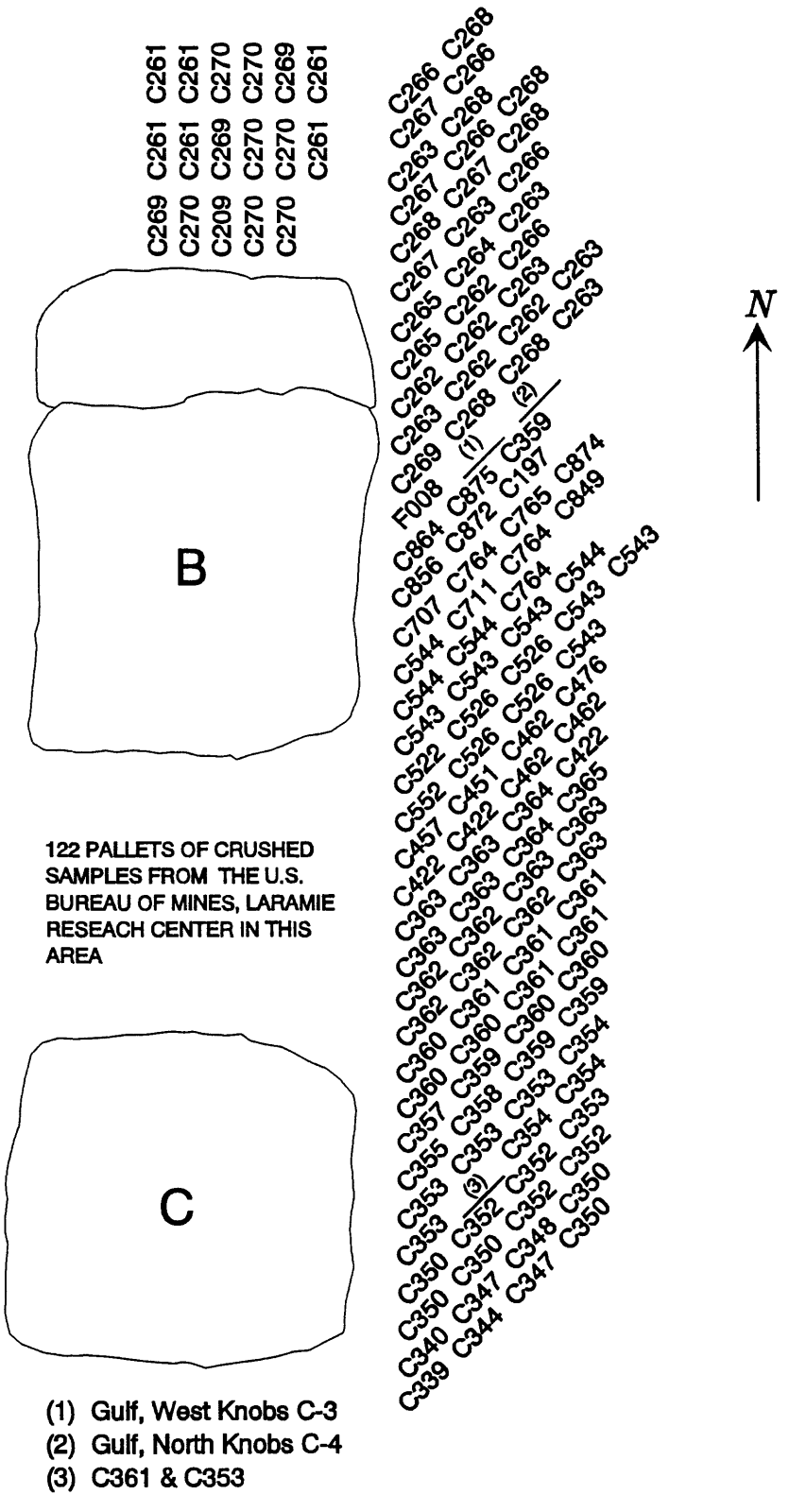

Figure 7.---Identification of pallets of drill cores around pillars B and C.

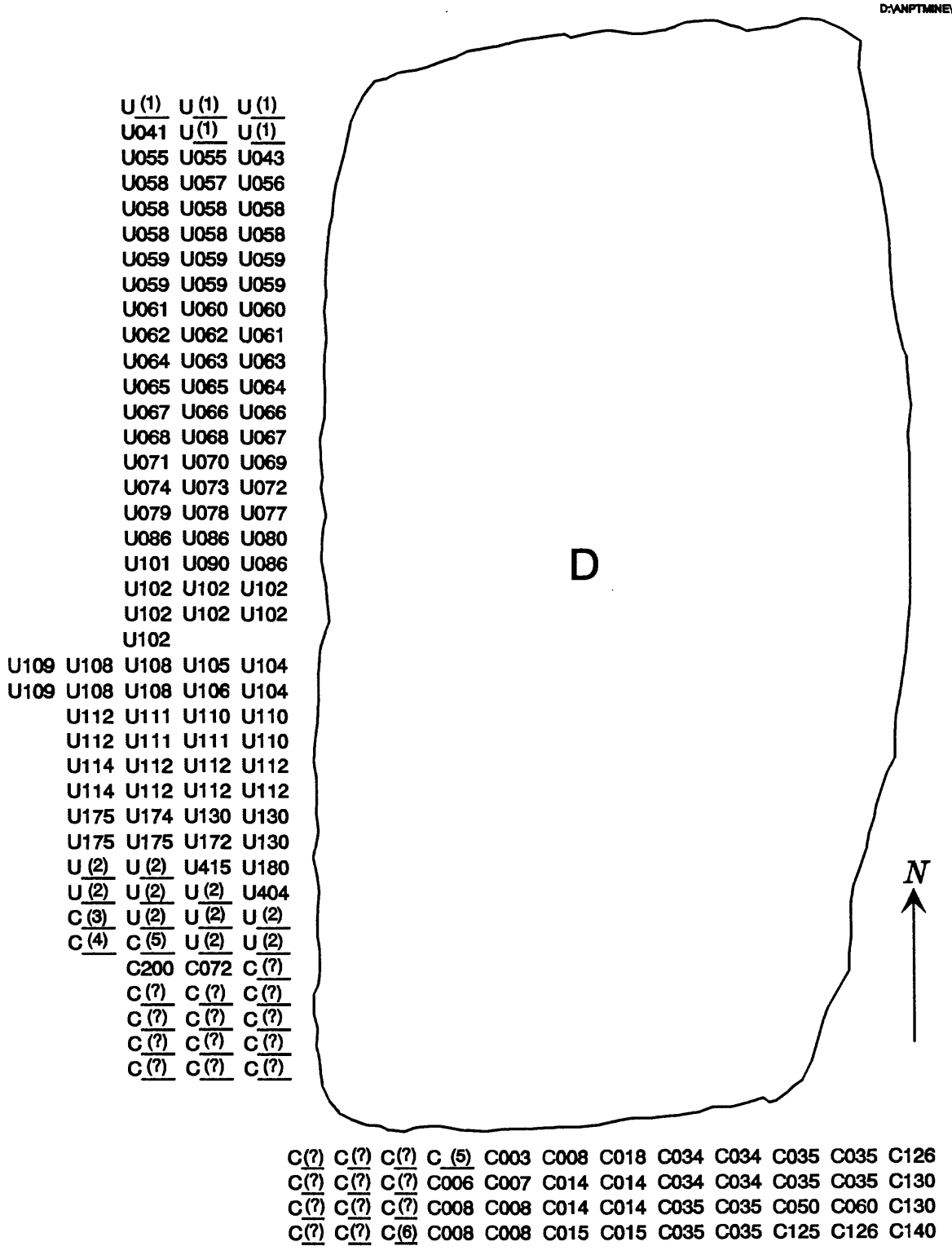

Figure 8.— Identification of pallets of drill cores around pillar D.

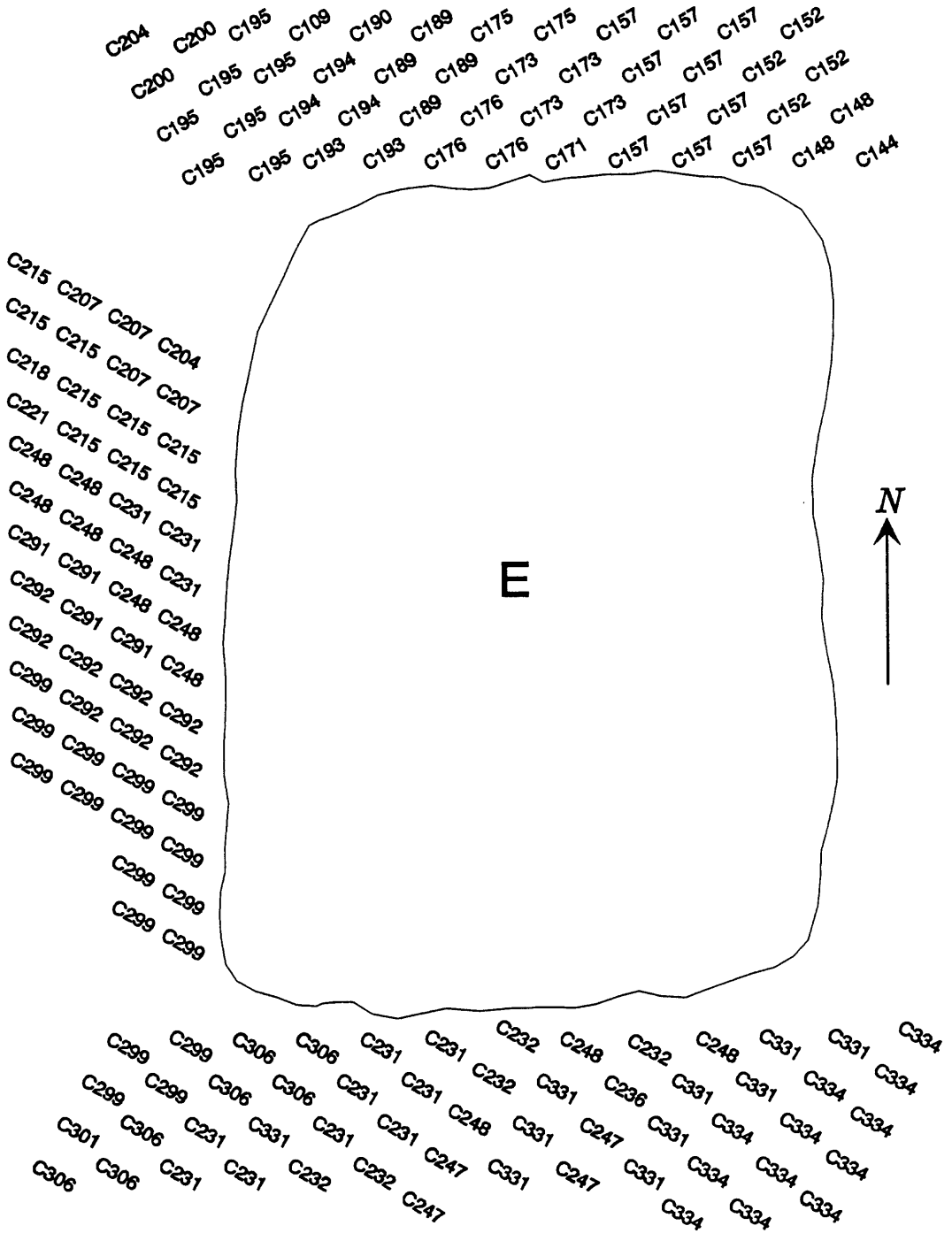

Figure 9.—Identification of pallets of drill cores around pillar E.

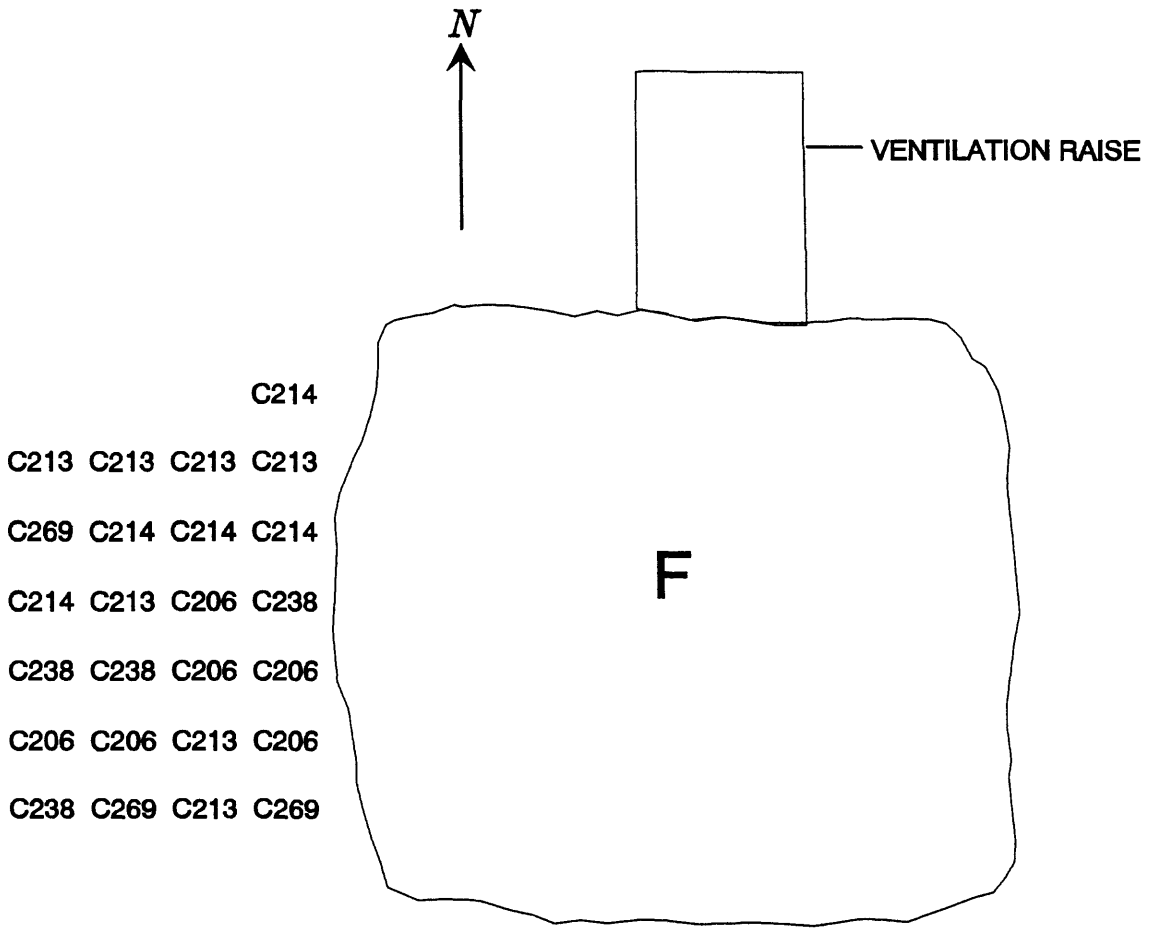

Figure 10. Identification of pallets of drill cores west of pillar F.

APPENDIX

United States Department of the Interior

TAKE PRIDE IN AMERICA

GEOLOGICAL SURVEY
BOX 25046 M.S. 939
DENVER FEDERAL CENTER
DENVER, COLORADO 80225

IN REPLY REFER TO:

August 26, 1993

RECEIVED

AUG 31 1993

NPR-3 WYO

NPR #3		
Code	Initials	Date
~~00~~	[illegible]	8-31
01	[illegible]	8-31
03		
031		
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041 - copy please

Determine feasibility + costs involved to USG + legal + safety issues + recommend.

Mr. Ray Williams
U.S. Department of Energy
907 North Poplar, Suite 100
Casper, Wyoming 82601

Dear Mr. Williams:

For the past three years, the U.S. Geological Survey has been preparing a collection of about 250,000 ft of oil-shale drill core from hundreds of bore holes for archival at the USGS Core Research Center, Lakewood, Colorado under a cooperative program between the USGS and the DOE. The work is coordinated through Mr. Keith Westhusing, Director, the Liquid Fuels Technology Branch, DOE, in Laramie, Wyoming.

Over the years, the USGS has acquired a large collection of oil-shale drill cores, mostly from the Green River oil shale deposits in Colorado, Wyoming, and Utah. This collection also includes cores from bore holes drilled by the former DOE Laramie Energy Technology Center (LETC) as well as thousands of crushed samples of drill cores that were used to make shale-oil analyses by LETC. These cores and samples are very valuable for resource evaluation of the Green River oil-shale deposits and for developing methods of recovering energy and mineral products from this enormous resource.

Because of recent cancellation of DOE funding for oil-shale projects, funds for core archival will probably not be available after FY 1993. Since the CRC is limited in space for core storage because of new sample and core collections, we are looking at the possibility of discarding a large amount of the oil-shale core, some of which includes the LETC collections of cores and crushed samples. In addition, as many as four energy companies have recently asked the USGS to take their collections of oil-shale cores.

In view of the above situation, I have been investigating alteratives to preserving the oil-shale drill cores and samples. One possibility is to store the cores in the Federal Anvil Points oil-shale mine near Rifle, Colorado. I have not yet estimated the total amount of core that we

would want to store there, but it would no doubt amount to many tons. After we have completed a review of the cores on hand and review those we plan to discard, and those we wish to keep for future reference, I can give you a better estimate of the tons of core materials and space required. We would keep all of the archived cores and a number of the unarchived cores at the CRC, but the additional cores that would be desirable to retain would be stored at the Anvil Points mine.

The drill cores are presently stored on pallets, each weighing about 2,000 lbs. The pallets would be stored in several rooms in the mine in such a way that individual pallets could be easily retrieved. The pallets would be wrapped in plastic to keep out moisture and dirt. A dry portion of the mine for long-term core storage is important. The mine road would need to be accessible to trucks and ventilation air and lights in the mine would be needed. Mine security would need to be addressed.

If a place for long-term storage of these cores cannot be found, we are looking at discarding many valuable cores and samples because of lack of storage space. Since many of these cores are from bore holes drilled are on public lands for which the Federal Government is responsible, it would be remiss if we did not make the effort to preserve them.

If you believe that that this idea has merit, I would recommend that the mine and mine access road be examined by Mr. Westhusing, myself, and a representative from your office to determine if the idea is feasible. We would also need to discuss the costs and funding for cleaning up several rooms in the mine, core moving costs, etc.

Sincerely yours,

John R. Dyni
Geologist

cc: Chief, BSP
Houseknecht
Westhusing

PROPOSAL TO STORE OIL-SHALE CORES IN THE DOE ANVIL POINTS OIL-SHALE MINE

December 1, 1993
(Revised April 11, 1994)

Prepared by John R. Dyni
U.S. Geological Survey
Mail Stop 939, Building 25
Denver Federal Center, Colorado 80225

Proposal

This project proposal to the U.S. Department of Energy and the U.S. Geological Survey includes preparing a part of the DOE Anvil Points Oil-Shale Demonstration mine for long-term storage of oil shale drill cores and crushed samples obtained from the U.S. Geological Survey in Denver, the Chevron Oil Company, and possibly from a DOE facility in Laramie, Wyoming. Included in the proposal is the cost of shipping of about 600 pallets of oil-shale drill cores from the U.S. Geological Survey's Core Research Center in Lakewood, Colorado to the DOE Anvil Points oil-shale mine near Rifle, Colorado for long-term storage. An option includes the cost of shipping about 400 tons of oil-shale materials from a DOE storage facility near Laramie, Wyoming to the mine.

The work is divided into five tasks: (1) preparation of a portion of the Anvil Points mine for storing the drill cores which includes moving several muck piles of oil shale in the proposed core storage area to other parts of the mine and cleaning the floor of the core storage area, (2) preparation and shipping about 600 pallets of oil-shale drill cores and samples at the USGS Core Research Center from Lakewood to the mine (3) moving about 1,100 pallets of oil-shale cores from a staging area near the old Anvil Points retort site into the mine, and, optionally, (4) preparation and (5) shipping 400 tons and 48 barrels of oil-shale materials from a DOE storage site near Laramie, Wyoming to the mine.

The total costs for Tasks 1,2 and 3 are estimated at $38,910. The costs for optional tasks 4 and 5 are estimated at $13,560, for a total cost of $52,470. Because a significant number of drill cores and and all of the crushed samples were from the former DOE Laramie laboratory, the costs should be shared on the basis of 2/3 from the DOE and 1/3 from the USGS. If weather conditions permit, the work would begin on about May 1, 1994 and be completed by May 31, 1993.

Background information

In 1991 a cooperative project was initiated between the U.S. Geological Survey (USGS) and the U.S. Department of Energy (DOE) to prepare a large collection of oil-shale drill cores for permanent storage at the USGS Core Research Center in Lakewood, Colorado and to prepare a PC computer database on oil shale. Funding for the project ended September 30, 1993. This proposal concerns the preservation of the unarchived drill cores and a collection of crushed samples of oil shale.

The oil-shale drill cores totals 215,000 lineal ft of which 20 percent have been prepared for archival. About one-half of the archived core was prepared under the cooperative program. About 170,000 ft of unprocessed oil-shale cores about 600 pallets of materials) remain to be archived. Many drill cores, as well as a large collection of crushed samples of oil shale, were obtained from the former DOE Laramie Energy Technology Center. Drill cores were also donated by energy companies and many of these are on Federal oil-shale lands. The cost to duplicate this collection of drill cores, crushed samples, and analytical data probably exceeds $50 million.

Recent acquistions of drill cores from oil and gas tests, transfer of the complete Amstrat sample library to the CRC, and construction of an ice core library at the CRC has drastically reduced the amount of available space for storage of unprocessed drill cores. For these reasons, it is now necessary to consider alternatives for storing the oil-shale cores and samples elsewhere, especially since additional DOE funding for their archival is unlikely.

The cores and crushed samples comprise a valuable collection of rock materials for present and future research. These materials can be used for laboratory testing of new technologies for recovering shale oil and byproducts, for making detailed assessments of the mineral resources, and for making chemical analyses to establish baseline data for environmental studies. Therefore, the Federal Government should preserve this valuable collection for present and future research by industry, institutions, and governmental agencies.

PROPOSED WORK

It is proposed that as many as 1,120 pallets of unprocessed oil shale drill cores from the Green River Formation in Colorado, Wyoming, and Utah be stored in the DOE Anvil Points oil-shale demonstration mine west of Rifle, Colorado.

About 600 of these pallets pallets are currently stored at the U.S. Geological Survey's Core Research Center, Lakewood, Colorado. About 120 pallets of drill cores and samples from Chevron Oil Company which are currently stored in Grand Junction, would be included.

An option to this proposal includes the preparation of about 400 tons of raw and retorted oil shale and 18 barrels of shale oil stored in Laramie, Wyoming by the DOE Liquid Fuels Technology Branch. This office has indicated that it may want to store these materials in the mine. However, other options including disposal of these materials in a local landfill is also being considered.

The work includes (1) cleanup of a portion of the mine for long-term storage cores and crushed samples of oil shale, (2) banding and wrapping about 600 pallets of drill core and their transportation from the USGS Core Research Center, Lakewood, Colorado to the mine, (3) off-loading of pallets arriving from Denver (and possibly from Laramie) at a staging area at the foot of the mine road and transporting the pallets on smaller trucks into the mine, and optionally, (4) the preparation and (5) transportation of about 400 tons of crushed oil shale and 48 barrels of shale oil from Laramie, Wyoming, to the mine. These materials are currently stored by DOE Liquid Fuels Technology Branch, Laramie, Wyoming in the University of Wyoming Agronomy building several miles west of Laramie.

In addition to this proposal, a memorandum of understanding between the DOE and the U.S. Geological Survey should be prepared to include provisions for maintaining an inventory of materials being stored in the mine, how the mine can be accessed to retrieve and store additional oil-shale materials, and for inspection and maintenance of the cores in the mine, mine caretaker functions, mine road maintenance, and other aspects that may apply.

ANVIL POINTS MINE AS A CORE STORAGE FACILITY

The Anvil Points demonstration mine was originally developed by the U.S. Bureau of Mines as an experimental facility to investigate methods of mining and retorting of oil shale. The mine was last operated in 1983 and has been closed until 1993, when it was reopened for removal of 10,000 tons of mine-run oil shale by New Paraho Corp. The Anvil Points selective mine, developed just east of the demonstration mine, is not considered for core storage in this proposal.

During the fall of 1993, two brief visits were made to the Anvil Points demonstration mine in company of Mr. Edward Cooley, manager of the New Paraho oil-shale plant. An area in the west part of the mine was tentatively chosen where

conditions appeared to be most favorable for core storage shown by a dashed line in figure 1. The proposed core storage area lies one pillar east of the north-south haulage way along the west side of the mine, which allows room for further mining and removal of oil shale from the mine without disturbing the core storage area.

In the proposed core storage area, the mine roof, which is at a height of 40 ft, is well bolted and shows no evidence of rock spalling or weak roof conditions. However, about 150 ft to the southeast, roof falls have occurred and roof conditions are hazardous (figure 1). The area of hazardous roof conditions is marked with warning signs and should not affect the core storage area.

The west part of the demonstration mine appears to be dry except for the room in the northwest corner of the mine about 200 ft northwest of the proposed core storage area. Here, the room has been deepened about 15 ft and it serves as a sump for water seeping from the ribs in this part of the mine. Some moisture was also noted along fractures near the portals of adits 1 and 2. However, no water seepage was noted in the proposed core storage area.

Dust will probably be a problem, especially if additional mining is carried out. Therefore, it would be desirable to cover the pallets of cores and samples with plastic sheets. Because of the height of the mine, it would not be feasible to erect barrier walls of plastic sheeting to seal off the core storage area.

The proposed core storage area encompasses about 22,750 square feet, which should be ample to store as many as 1,000 pallets of standard size (36.5x45 inches), stacked two pallets high (figure 2). Several muck piles totaling about 3,200 yards, will need to be moved to rooms east of the storage area. The floor of the area should be cleaned by hosing with water. Several truck loads of water would be required.

Workmen with mine safety training will be needed to truck the cores into the mine and to unload the trucks with a forklift. A 10-ton flatbed truck can be driven into the mine to the core storage area and the pallets removed by a forklift.

MINE VENTILATION

A six-foot diameter flexible cloth ventilation tube and fan are present along the west haulage way. A generator will need to be rented to operate the ventilation system when the workers are cleaning the core storage area and moving pallets into the mine.

MINE ROAD

The road from the foot of the cliff near the old Anvil Points retort facility to the mine bench is 5 miles long and includes several steep switchbacks. The road at the time of the last visit was in good condition and can accomodate about a 10-ton flatbed truck. Larger tandem-axle highway rigs would not be able to use the road. The mine road would not be useable during wet weather. It will be necessary to unload the pallets from 18-wheel flat bed truck/trailers at the base of the mine road, then haul the pallets into the mine to the core storage area on smaller trucks.

STAGING AREA

An area near the old Anvil Points retort site will be selected for unloading the pallets of cores and samples arriving from Denver, and possibly from Laramie for transfer to smaller trucks for hauling the core up the mine road into the mine.

ESTIMATED COSTS

Task 1.--Mine work including moving several muck piles and cleaning the floor in the proposed core storage area.

A) Rental of generator set for operating the mine ventilation system, @ $800/month for 2 months $1,600

B) Diesel fuel for a generator to operate the ventilation system..... $500

C) Move about 3,200 yards of oil-shale muck several hundred ft into rooms east of the core storage area. Estimated 5 days work with a 10-yard loader @ $700/day including transportation of loader to and from the mine $3,500

D) Clean and wash floor in the proposed core storage area $1,500

E) Plastic sheeting for covering palleted cores in the mine $250

Task 2.

A) Preparation of about 600 pallets of core at the USGS Core Research Center for transportation to the Anvil Points mine includes banding and covering each pallet with plastic for shipping $2,500

B) Transportation of 600 pallets from the USGS Core Research Center, Lakewood, Colorado to the staging area at Anvil Points mine near Rifle, Colorado (27 truckloads @ $488/truckload) $13,310

Task 3. Transportation of the cores and crushed samples from the staging area to the core storage area in the mine by workers mine-safety certified to work underground, 100 truckloads @ ~~$75~~/truckload including forklifts for loading and unloading the pallets $22,750

Supervision of the work at the mine by a consulting geologist familiar with oil-shale drill cores @ $550/day including lodging, meals, and transportation for 15 days $8,250

Grand total $54,160

WORK SCHEDULE

The work would began on about June 1, 1994 when the mine road is dry and safe to travel. The entire project to clean up the proposed area for core storage in the mine and shipping the cores from Denver and into the mine should be completed in 30 working days. The work at mine would be supervised by a consulting geologist, probably one a part-time basis (approximately 2-3 days per week) for the duration of the project.

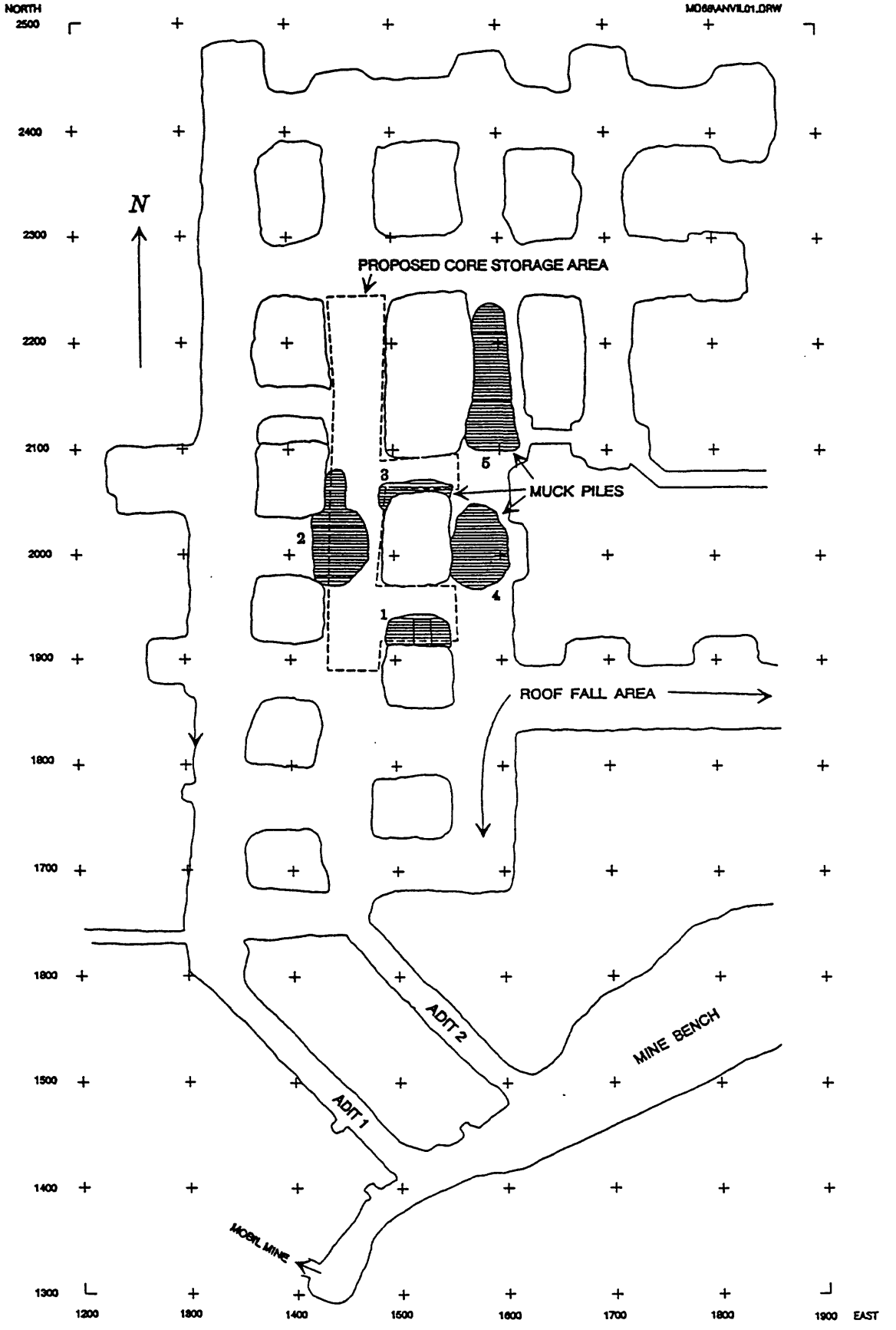

Figure 1.---Plan of west side of the Anvil Points Demonstration Mine

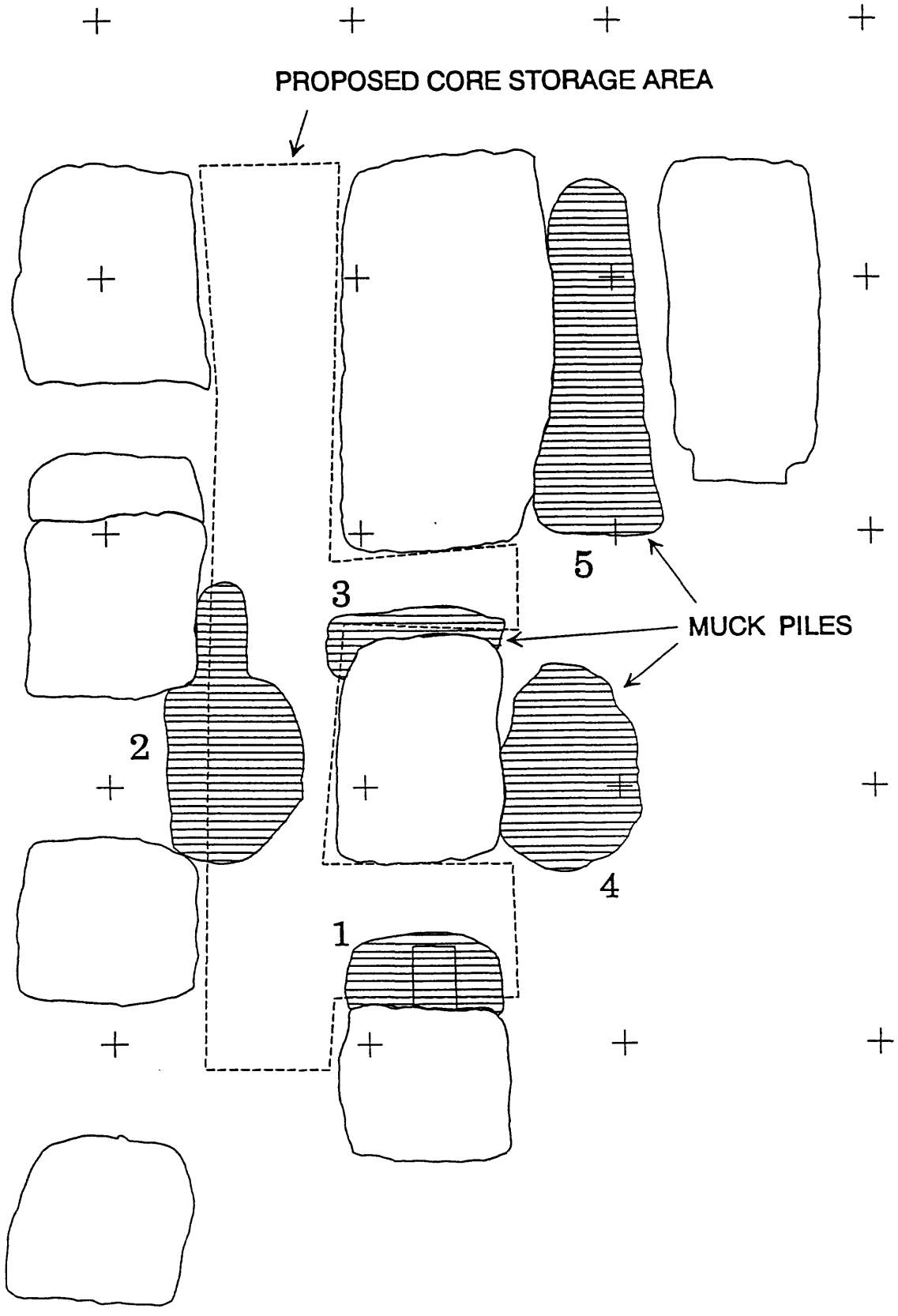

Figure 2.---Enlarged plan view of the proposed core storage area.

Department of Energy
Naval Petroleum and Oil Shale Reserves
in Colorado, Utah and Wyoming
907 N. Poplar, Suite 150
Casper, Wyoming 82601

May 31, 1996

Serial No:DJN/041.655

Mr. Thomas Michalski
Chief, USGS Core Research Center
U.S. Geological Survey
Mail Stop 975, P.O. Box 25046
Denver, CO 80225-0046

Dear Mr. Michalski,

Enclosed is the signed MOU for Storage of Oil Shale Core at the Anvil Points Mine in Colorado. Thank you very much for your cooperation and initiative in making this project work.

If we can be of further assistance, please call Dan Newquist at (307) 261-5161, extension 5073.

Clarke D. Turner
Director

Enclosure:
As stated

cc: CAPT Hunter, FE-60 (w/o encl)
Arney Smits, FE-62 (w/o encl)

lj/5810/wp

1240

MEMORANDUM OF UNDERSTANDING

BETWEEN

UNITED STATES
DEPARTMENT OF ENERGY

AND

UNITED STATES
GEOLOGICAL SURVEY

FOR

STORAGE OF
OIL SHALE CORE
AT ANVIL POINTS MINE

I. PURPOSE

The purpose of this Memorandum of Understanding (MOU) is to establish general guidelines for the storage of oil shale cores within the custody of the U.S. Geological Survey (USGS) at the Department of Energy's (DOE) Anvil Points mine located on Naval Oil Shale Reserves No. 1 near Rifle, Colorado.

II. BACKGROUND

The Core Research Center of the USGS, located in the Denver Federal Center, has acquired a large collection of oil shale cores and crushed samples from exploratory drilling (by the DOE, USGS, and others) of the Green River oil shale deposits of Colorado, Wyoming, and Utah. This collection is an irreplaceable source of materials for testing new oil shale technologies and represents an original investment exceeding $20 million. With tightening budgets, this valuable collection of cores is in danger of being lost because the USGS no longer can afford the high cost of warehousing the collection at the Denver Federal Center.

III. AUTHORITY

A. Department of Energy Organization Act of 1977 (Public Law No. 95-91), 42 USC 7101 et seq .

B. Naval Petroleum Reserves Production Act of 1976 (Public Law No. 94-258), 10 USC 7420 et seq .

C. 43 USC 31 et seq .

IV. GENERAL MANAGEMENT AND RESPONSIBILITIES

A. The interests of DOE and the USGS in Anvil Points and the oil shale cores, respectively, will not be regarded as changed or altered in any manner by this agreement. DOE retains exclusive jurisdiction and control over the Anvil Points mine and the space designated for storage of the core collection. The USGS retains ownership of all cores and samples in the collection, including cores and samples obtained at an earlier date from DOE.

B. The USGS will be responsible for management and maintenance of

core materials in the designated core storage area, and for records management. Oil shale cores from deposits other than the Green River Formation may be added to the collection, but no non-oil shale cores will be stored in the mine.

C. DOE will reserve part of the Anvil Points mine for long-term storage of oil shale cores and samples. DOE, to the maximum extent practicable, will conduct any future mining activities in a manner that will minimize the risk of damage to the cores or core storage area.

However, DOE assumes no liability for damage or loss of core while it is being stored in the mine. If mining takes place, availability of the core storage area for viewing or sampling may be temporarily restricted.

D. The USGS and DOE will ensure, to the maximum extent practicable, that appropriate safety measures are implemented to protect all persons entering the mine. Non-government visitors to the mine will be required to assume liability for their own safety.

E. DOE and USGS will prepare and implement project plans or interagency agreements which set forth specific cooperative arrangements and procedures for core storage. For example, project plans will specify the initial preparation, including the removal of muck piles and old equipment, of the portion of the Anvil Points mine set aside for the core storage. DOE and the USGS will consult from time to time regarding implementation of this MOU. Agency coordinators for this MOU are identified in Section X below.

F. The USGS and DOE will provide each other with reports, and other information as requested, within ninety days of the end of the fiscal year, giving the annual expenditures, sources of funding, and statistics of visits and usage, as applicable. Such reports will include a narrative description of specific work projects, to the extent this information is available, and will identify future needs.

V. OPERATING GUIDELINES

A. The core storage area will be open to the public (persons, other than USGS and DOE personnel, over 18 or accompanied by persons over 18) for examination during the last full work week of each month. This inspection period may change as road and mine

conditions, funding, weather, or interest in sampling or viewing the cores changes.

B. The core storage area will be open at other times to USGS and DOE personnel for core examination and sampling.

C. All core inspection or sampling will be coordinated through the USGS. The USGS will provide personnel to assist the public during the inspection period.

D. DOE will have access to the core storage area as needed for mine maintenance or safety inspections at no expense to the USGS.

E. The USGS will remove core stored in the mine:
(a) upon termination of the MOU and DOE's request that the cores be removed, and;
(b) if funds and manpower are available for this purpose.

VI. PROJECT FUNDING

A. The initial costs of preparing the designated portion of the mine for core storage and moving the core from the Denver Federal Center to the mine will be shared by the USGS and DOE.

B. This MOU shall not be used to obligate or commit funds or as the basis for the transfer of funds. The details of the levels of support to be furnished one organization by the other with respect to funding will be developed in specific interagency agreements or other appropriate funding documents, subject to the availability of funds.

C. Certain operating expenses associated with core storage at Anvil Points, including travel by USGS personnel to and from the mine, and lighting and ventilation in the core storage area when it is open to the public, will be paid by the USGS. Operating expenses for maintenance of the mine, mine access road, and underground access to the core storage area in the mine will be paid by the DOE. If the funds or staff are not available, the core storage area may be closed to the public.

VII. PUBLIC INFORMATION COORDINATION

Subject to the Freedom of Information Act (5 USC 552), decisions on disclosure of information to the public will be made following consultation between DOE and USGS.

VIII. AMENDMENT AND TERMINATION

This MOU may be amended by written agreement between DOE and the USGS and may be terminated by either DOE or the USGS on 90 days advance written notice of termination.

IX. EFFECTIVE DATE

This MOU shall become effective when signed by both parties. It shall remain in effect for a five-year term from the effective date.

X. AGENCY CONTACTS

A. U.S. Department of Energy:
Dan Newquist, Oil Shale Manager
907 N. Poplar St., Suite 150
Casper, Wyoming 82601
307/261-5161, ext. 5073
307/261-5817 (fax)

B. U.S. Geological Survey:
J.R. Dyni
MS 939 Federal Center
Denver, Colorado 80225-0046
303/236-5544 (Office)
303/665-6922 (home)

Thomas Michalski
MS 975 Federal Center
Denver, Colorado 80225-0046
303/202-4852 (Office)
303/202-4856 (fax)

XI. SIGNATURES

For the U.S. Department of Energy:

4/24/96
Date

Captain Ernest R. Hunter, CEC, USN
Deputy Assistant Secretary for Naval Petroleum and Oil Shale Reserves
U.S. Department of Energy

For the U.S. Geological Survey:

3/6/96
Date

Thomas D. Fouch
Acting Regional Geologist, Central Region
U.S. Geological Survey