

<p>CECW-EG</p> <p>Engineer Regulation 1110-2-103</p>	<p>Department of the Army U.S. Army Corps of Engineers Washington, DC 20314-1000</p>	<p>ER 1110-1-103</p> <p>10 December 1981</p>
	<p>Engineering and Design</p> <p>STRONG-MOTION INSTRUMENTS FOR RECORDING EARTHQUAKE MOTIONS ON DAMS</p>	
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DAEN-CWE-SG

Regulation
No. 1110-2-103

10 December 1981

Engineering and Design
STRONG-MOTION INSTRUMENTS FOR RECORDING
EARTHQUAKE MOTIONS ON DAMS

1. Purpose. This regulation provides requirements and guidance for installation and servicing of strong-motion instruments for recording earthquake motions on Corps of Engineers (CE) dams.
2. Applicability. This regulation applies to all field operating activities having civil works responsibilities.
3. References.
 - a. EM 1110-2-1908 Chapter 3, Part 2 of 2.
 - b. EM 1110-2-4300, Chapter 7.
4. General. All dams in seismic risk zones 2, 3, and 4 of the Seismic Risk Maps (Appendix A) should be instrumented for strong-motion earthquake measurements. Guidance on details of instrumentation location and selection is given in references 3a and 3b. By interagency agreement, the Seismic Engineering Branch (SEB) of the US Geological Survey (USGS) is responsible for the installation and maintenance of approximately 200 accelerographs located at Corps dams in the western coast region and surrounding areas of the United States. Those instruments located in the central and eastern United States areas will be installed and serviced by the Waterways Experiment Station (WES). Some non-Corps instruments in custody of the USGS, located in the WES service region, will be serviced by WES on a one-for-one tradeoff basis with USGS. This arrangement is beneficial because travel costs for maintenance of CE instruments are minimized. In an effort to increase the reliability and overall effectiveness of the Strong-Motion Instrumentation Program (SMIP), it will be necessary, periodically, to modify and/or upgrade various instruments as maintenance records dictate and as technological advances are made. On an annual basis, WES will prepare an Engineer Circular which will serve as a status report for the CE SMIP. Included therein will be current estimated costs for the installation and servicing of instruments and a tabulation of strong-motion instrumentation, both operational and planned. Charges for those services may be adjusted annually on the basis of actual cost experience. Transfer of funding authority to WES should be made on an annual basis via Intra-Army Order for Reimbursable Services (DA Form 2544), with expiration date no sooner than 31 January of the next calendar year.

This regulation supersedes ER 1110-2-103, 9 Aug 74

Presently, service visits will be made on a biannual basis, and billings to the districts against this authority will be made in the same manner. New instruments purchased by the field should be coordinated with USGS in the western region and WES in the central and eastern regions before procurement is made (See Appendix B for service agency.). WES and USGS may request that the instruments be shipped to their respective offices for calibration or modification before installation.

5. WES Responsibilities. WES will be responsible for: (a) maintaining records of instrument servicing and location, (b) reviewing instrument locations and type to assure conformance with OCE policy, (c) processing and analyzing records that will be obtained, (d) furnishing copies of records obtained to the district concerned, (e) coordinating with USGS and the districts to establish schedules for inspection visits, (f) billing districts for services provided, (g) reimbursing USGS for expenses incurred, (h) providing instrumentation services personnel for installation and maintenance of CE instruments not serviced by USGS, (i) providing (by letter) an annual cost estimate to each district served, and (j) providing a draft of an annual Engineer Circular on the status of the program to CDR USACE (DAEN-CWE-SG) WASH DC 20314 for Corps wide distribution.

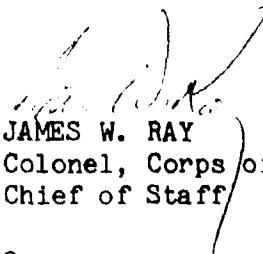
6. List of Seismic Instrument Installations. A tabulation of strong-motion instrumentation now operational or planned at CE projects is attached as Appendix B (revised March 1981). This list will be revised annually and published in the Engineer Circular discussed in paragraph 4. Districts should review the list and notify the WES (through their division) of any necessary corrections or additions. Copies of correspondence should be sent to CDR USACE (DAEN-CWE-SG) WASH DC 20314 for information.

7. Review of Instrument Plans. When a structure is selected for installation, WES should be furnished plans for reviews. These plans should include drawings showing instrument types, locations, and details of the instrument shelters and foundations. SEB, USGS, also should be furnished copies of the drawings showing instrument type and shelter details, for their review in those areas which they service. Information copies of correspondence should be furnished DAEN-CWE-SG.

8. Guidance for Design of Seismograph Installations. Guidelines for design of seismograph installations are contained in references 3a and 3b above, copies of which may be obtained from WES. Other details may be clarified by contacting the Commander and Director, US Army Engineer Waterways Experiment Station, ATTN: WESGH, P.O. Box 631, Vicksburg, MS 39180.

FOR THE COMMANDER:

2 Appendixes
APP A - Maps
APP B - Tabulation


JAMES W. RAY
Colonel, Corps of Engineers
Chief of Staff

APPENDIX A

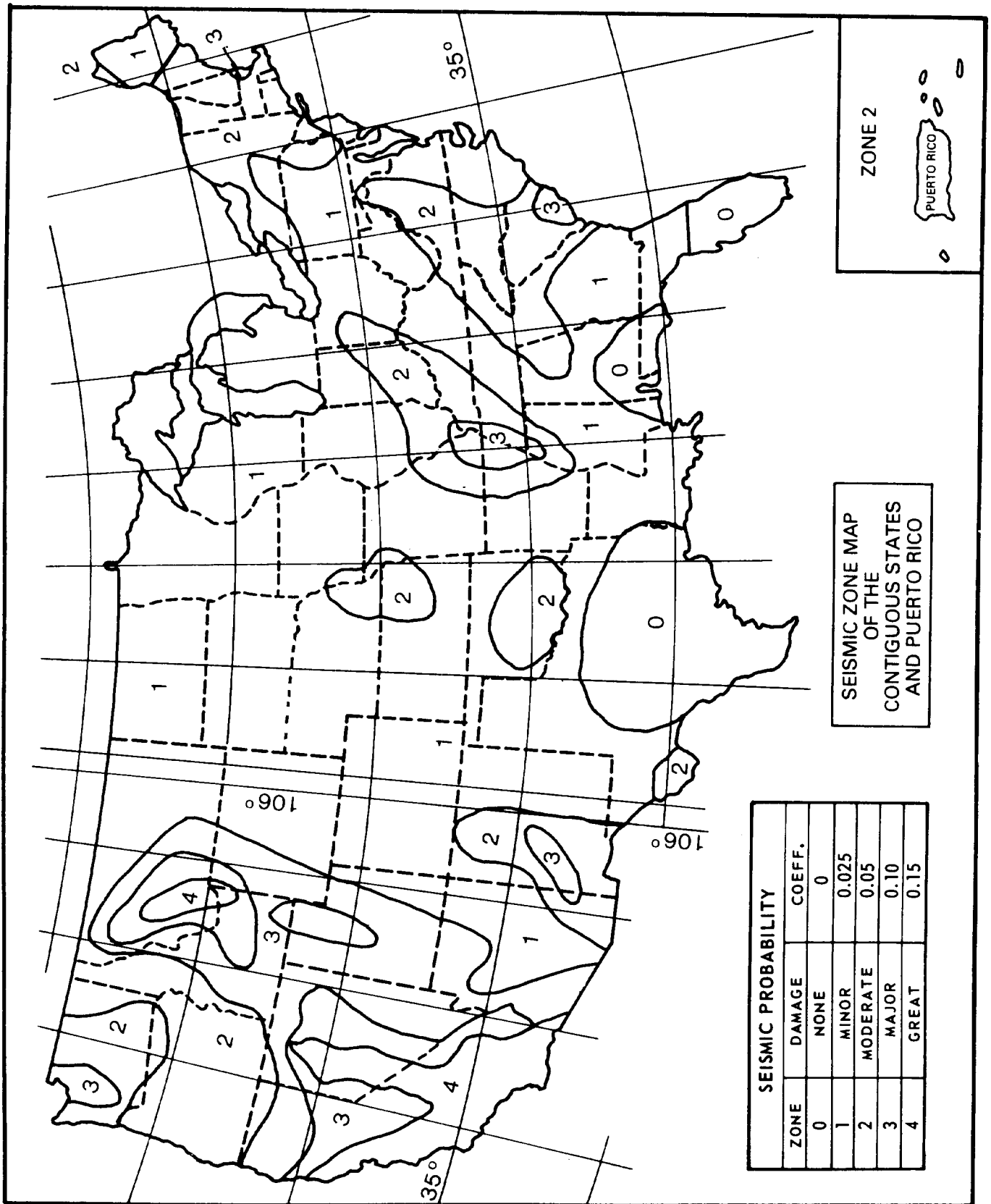


Figure A-1

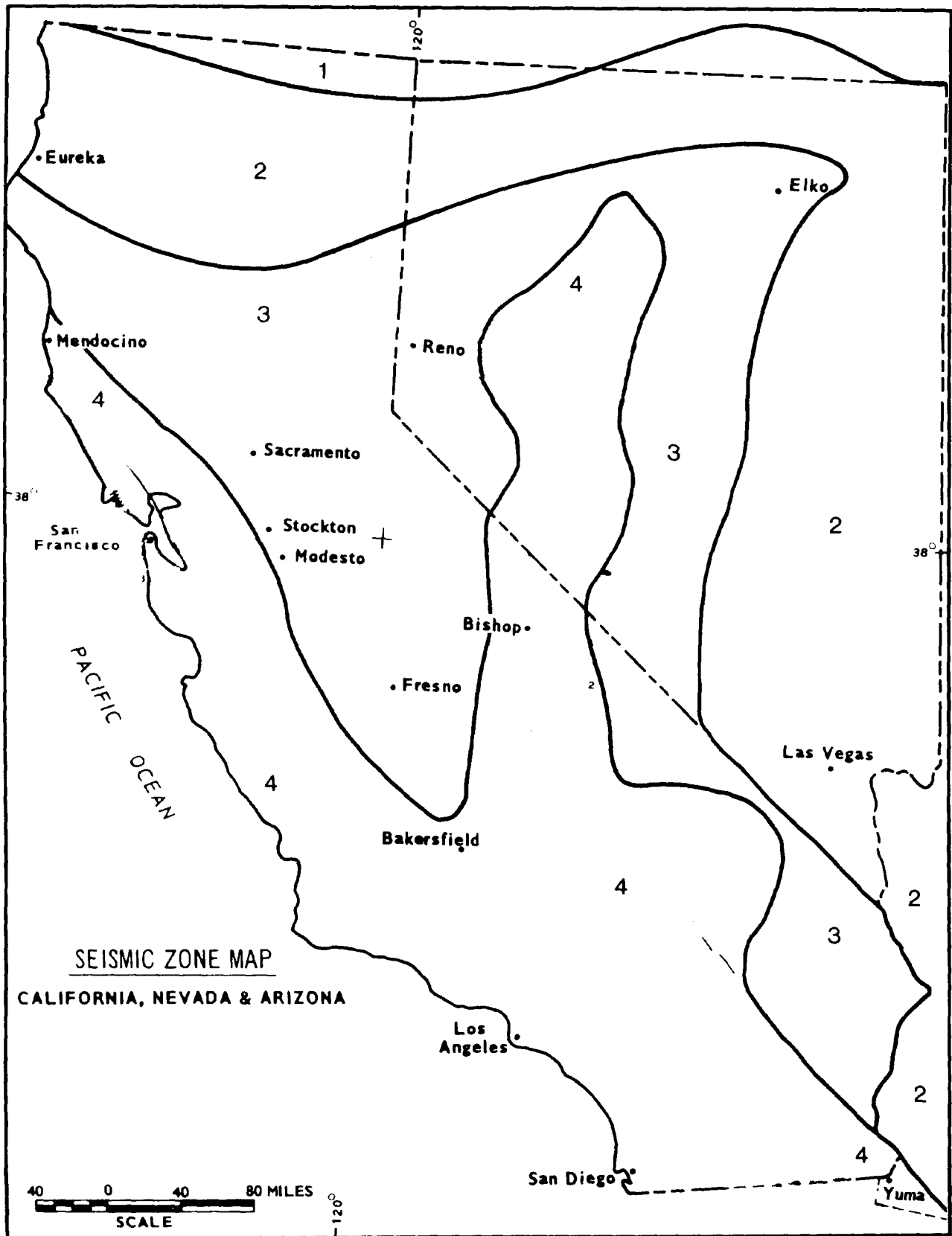


Figure A-2

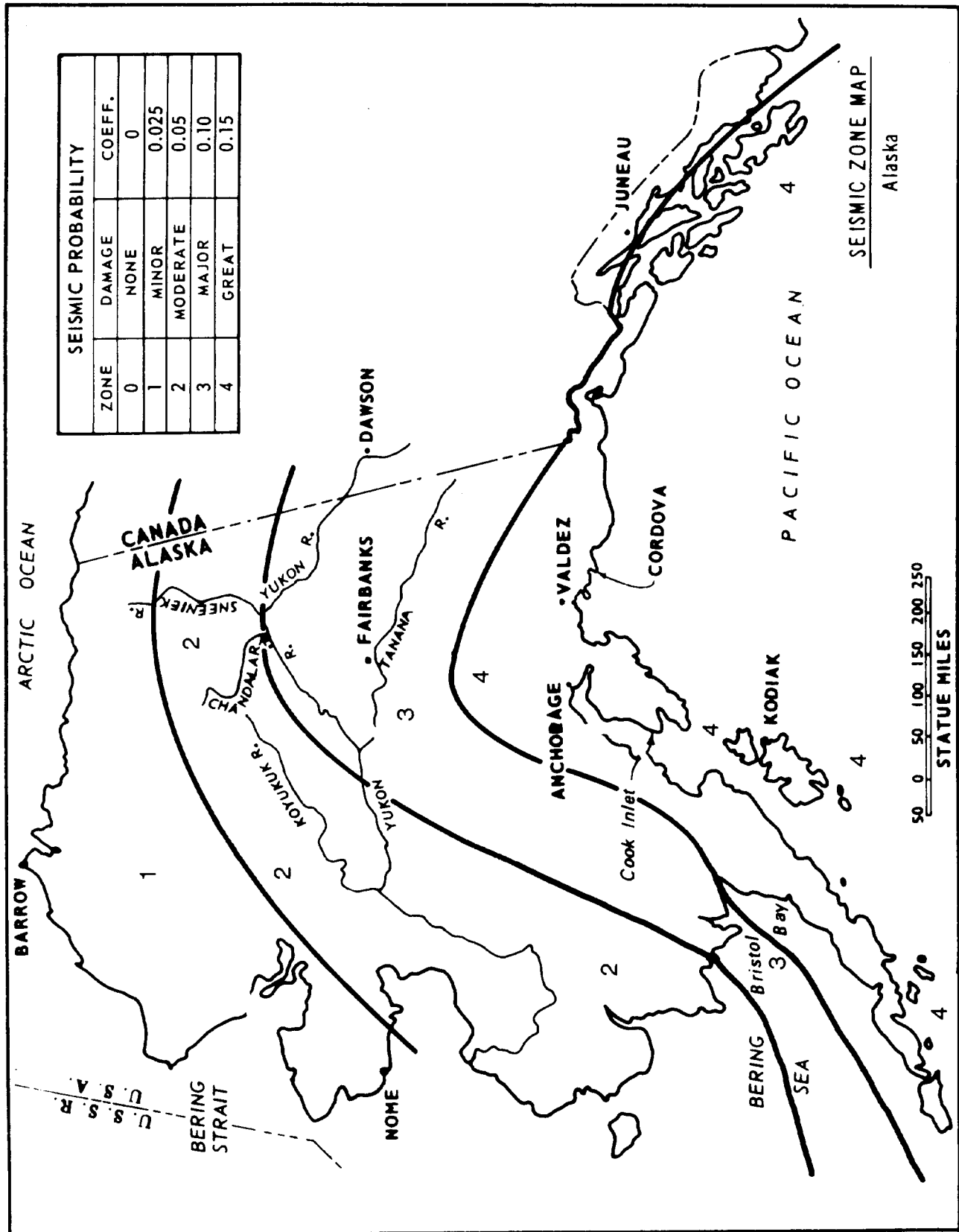


Figure A-3

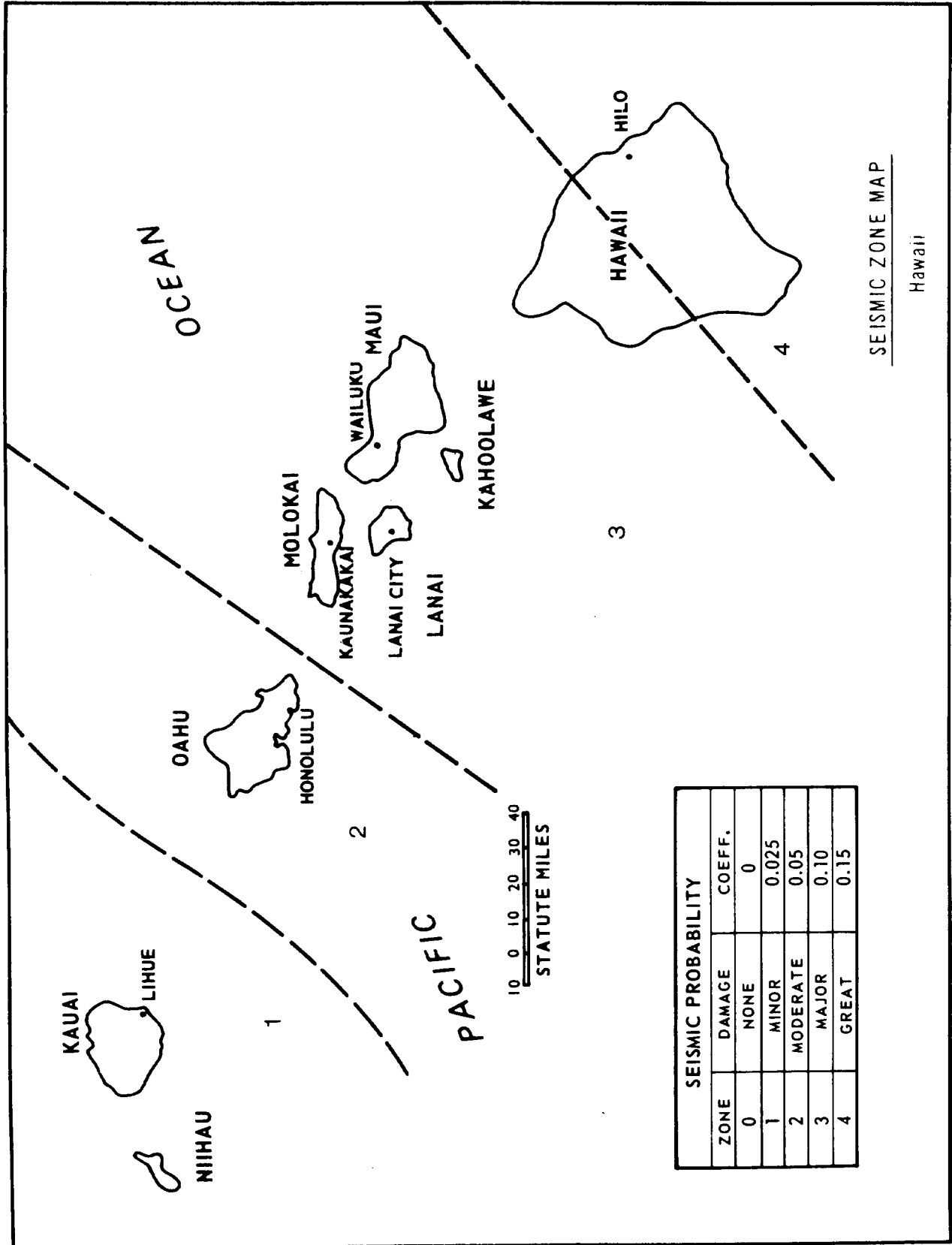


Figure A-4

STRONG-MOTION INSTRUMENTATION AT CE PROJECTS OPERATIONAL OR PLANNED
AND TO BE SERVICED BY SEISMIC ENGINEERING

Division	District	Project	Type (1)	H (m)	State	Accelerographs		Seismoscopes		Peak Accel.		Serviced By				
						Operational	Planned	Oper.	Plan.	Oper.	Plan.	USGS	WES			
NPD	Portland	Cougar	r.f.	136	OR	6-SMA-1	--	--	--	--	--	X	--			
		Green Peter	c.	111	OR	2-AR-240 1-SMA-1	--	5	--	Damage	--	--	X	--		
	Lookout Point	Lost Creek	Blue River	e. & r.	83	OR	6-SMA-1	--	--	--	--	--	X	--		
					104	OR	6-RPT-350	--	--	--	--	--	--	X	--	
					83	OR	5-SMA-1	--	--	--	--	--	--	X	--	
					138	OR	3-SMA-1	--	--	--	--	--	--	X	--	
					103	OR	3-SMA-1	--	--	--	--	--	--	X	--	
					60	OR	1-RPT-350	1	--	--	--	--	--	--	X	--
	Seattle	Applegate	Libby	gr.	--	OR	4-RPT-250(2) 3-SMA-1*	--	--	--	--	--	X	--		
					136	MT	2(3); 3-SMA-1	--	--	--	--	--	--	X	--	
					70	WA	3-SMA-1	--	--	--	--	--	--	--	X	--
					235	WA	2(3); 3-SMA-1	--	--	--	--	--	--	--	X	--
					130	WA	3-SMA-1	--	--	--	--	--	--	--	X	--
					55	WA	3-SMA-1	--	--	--	--	--	--	--	X	--
219					ID	4-SMA-1	--	--	--	--	--	--	6	X	--	
78					WA	5-SMA-1	--	--	--	--	--	--	5	X	--	
SPD	Walla	Lower Granite	e. & gr.	104	ID	4-SMA-1	--	--	--	--	--	X	--			
				40	AK	1-SMA-1	--	--	--	--	--	--	X	--		
	Los Angeles	Alamo	Brea	e.	86	AZ	2-RPT-250	1	2	--	--	X	--			
					27	CA	3-SMA-1	--	--	--	--	--	--	X	--	
	Whittier Narrows	Carbon Canyon	Mojave	e.	30	CA	3-SMA-1	--	--	--	--	--	X	--		
					61	CA	4-SMA-1**	--	--	--	--	--	--	X	--	
					37	CA	3-SMA-1	--	--	--	--	--	--	X	--	
					41	CA	1-SMA-1	--	--	--	--	--	--	X	--	
					49	CA	3-SMA-1	--	--	--	--	--	--	X	--	
					17	CA	2-RPT-250	--	--	--	--	--	--	--	X	--

* Two SMA-1 accelerographs were temporarily disconnected because of their proximity to a construction site.

** Power Supply became a severe problem; had to abandon this project.

(1) e. = earth, c. = concrete, r.f. = rock-fill, g.f. = gravel fill, e. & r. = earth and rock, e. & g = earth and gravel, gr. = gravity, and e.f. = earth fill.

(2) Installed by District personnel but to be serviced by USGS beginning FY 76.

(3) Tape recorded units, not serviced by USGS.

(Page 1 of 4)

Figure B-1

Division	District	Project	Type (1)	H (m)	State	Accelerographs		Seismoscopes		Peak Accel.		Serviced By	
						Operational	Planned	Oper.	Plan.	Oper.	Plan.	USGS	WES
SPD	Los Angeles	Mathews Canyon			NV		3-SMA-1						
		Painted Rock			AZ		3-SMA-1						
		Pine Canyon			NV		3-SMA-1						
		Tat Momolikot			AZ		3-SMA-1						
	Sacramento	Whitlow Ranch			AZ		3-SMA-1						
		Black Butte	e.		43	CA	2-RPT-250	3	2				X
		Isabella	e.		56	CA	2-RPT-350						X
		Martis Creek	e.f.		35	CA	5-RPT-250	6	5				X
		New Hogan	e. & r.		64	CA	1-RPT-350						X
		Pine Flat	c.		134	CA	5-SMA-1	2	2				X
MRD	San Francisco	Terminus	e.		76	CA	2-RPT-250						X
		Buchanan	r.f.		205	CA	1-RPT-350	3	3				X
		Hidden	e.		163	CA	3-RPT-250						X
		New Melones Lake	e.		43	CA	1-RPT-350	3					X
	Kansas City	Coyote	e.		50	CA	4-SMA-1	3					X
		Warm Springs	e.		97	CA	2-SMA-1	5					X
		Tuttle Creek	e.		47	KS	6-SMA-1						X
		Milford Dam	e. & r.f.		43	KS	3-RPT-250					3	
		Truman Dam	e.		40	MO	5-SMA-1						X
		Harlan County	e. & gr.		32	NE	2-SMA-1						X
Omaha	Kansas City	Kanopolis	r.f.		39	MO	2-SMA-1						X
		Fort Peck Dam	e.		76	MT	1-SMA-1						X
		Garrison Dam	e.g.		62	ND	3-SMA-1						X
		Oahe Dam	e.		75	SD	3-SMA-1						X
	Sacramento	Big Bend Dam	e.		29	SD	3-SMA-1						X
		Fort Randall	e.		50	SD	3-SMA-1						X
		Gavins Point Dam	e.		23	NE	3-SMA-1						X
		Cherry Creek Dam	e.		58	CO	3-SMA-1						X
		Chatfield Dam	e.		45	CO	5-SMA-1						X
		Bear Creek Dam	e.		17	CO	3-SMA-1						X
SND	Albuquerque	e.		77	NM	7-SMA-1		8				X	
	Little Rock	c.		71	AR	2-SMA-1							
	Kaw Dam	e.		37	OK	2-SMA-1							
NCD	Buffalo	Mt. Morris	gr.		75	NY	3-SMA-1		2				

Figure B-1 - continued.

Division	District	Project	Type (1)	H (m)	State	Accelerographs		Seismoscopes		Peak Accel.		Serviced By					
						Operational	Planned	Oper.	Plan.	Oper.	Plan.	USGS	WES				
LMVD	Memphis	Wappapello	e.	33	MO	3-SMA-1	--	6	--	--	--	X	--				
		Rend Lake	e.	17	IL	3-SMA-1	--	6	--	--	--	X	--	--			
	St. Louis	Arkabutla	e.	29	MS	3-SMA-1	--	6	--	--	--	--	X	X			
		Sardis	e.	35	MS	3-SMA-1	--	5	--	--	--	--	--	X	X		
	Pittsburgh	Kinzua	e. & gr.	55	PA	3-SMA-1	--	--	--	--	--	--	--	--	X	X	
		Tionesta	e.	47	PA	1-SMA-1	--	--	--	--	--	--	--	--	--	X	X
		East Branch	e.	56	PA	1-SMA-1	--	--	--	--	--	--	--	--	--	X	X
		Michael J. Kirwan	e.	25	OH	1-SMA-1	--	--	--	--	--	--	--	--	--	X	X
		R. D. Bailey			WV	--	4-SMA-1	--	--	--	--	1	--	--	--	--	--
		Bluestone			WV	--	1-SMA-1	--	--	--	--	--	--	--	--	--	--
Louisville	J. W. Flannagan			VA	--	5-SMA-1	--	--	--	--	--	--	--	--	--	--	
	Brookville	e. & r.f.	55	IN	3-SMA-1	--	--	--	--	1	--	--	--	X	X		
	Cagles Mill	e.	45	IN	2-RFT-350	1-RFT-350	--	--	--	1	--	--	--	X	X		
	Cannelton L&D		47	IN	2-SMA-1	--	--	--	--	1	--	--	--	X	X		
	Monroe	e. & r.f.	28	IN	3-RFT-350	--	--	--	--	1	--	--	--	X	X		
	Newburgh L&D			IN	2-SMA-1	--	--	--	--	1	--	--	--	X	X		
	Patoka			IN	2-RFT-350	--	--	--	--	1	--	--	--	X	X		
	Uniontown L&D			IN	2-SMA-1	--	--	--	--	1	--	--	--	X	X		
	Nolin River	e. & r.f.	50	KY	3-SMA-1	--	--	--	--	1	--	--	--	X	X		
	Rough River	e. & r.f.	45	KY	3-SMA-1	--	--	--	--	1	--	--	--	X	X		
Nashville	Smithland L&D			IL	5-RFT-350	--	--	2	--	1	--	--	X	X			
	Wolf Creek	e. & c.	79	KY	5-SMA-1*	--	--	2	--	1	--	--	X	X			
	Center Hill	e. & c.	76	TN	5-SMA-1	--	--	2	--	1	--	--	X	X			
	Barkley	e. & gr.	48	KY	6-SMA-1	--	--	2	--	1	--	--	X	X			
	J. Percy Priest	e. & c.	40	TN	5-SMA-1**	--	--	2	--	1	--	--	X	X			
	Dale Hollow	gr.	61	TN	4-SMA-1	--	--	2	--	1	--	--	X	X			
	Laurel River	r.f.	86	KY	2-SMA-1	1	--	--	--	1	--	--	X	X			
	Martin's Fork			KY	4-SMA-1	--	--	--	--	2	--	--	X	X			
	Ball Mt. Lake	e. & r.	81	VT	3-SMA-1	--	--	--	--	1	--	--	X	X			
	Colebrook R. Lake	e.	66	CT	--	2-RFT-350	--	--	--	--	--	--	--	--	--		
NED	Littleville Lake	e.	51	MA	3-RFT-350	--	--	--	--	--	--	--	X	X			
	Franklin Falls	e.	54	NH	3-RFT-350	--	--	--	--	--	--	--	X	X			
	Union Village	e.	54	VT	3-SMA-1	--	--	--	--	--	--	--	X	X			
	Everett	e.	43	NH	3-SMA-1	--	--	--	--	--	--	--	X	X			
	Hodges Village	e.	18	MA	3-SMA-1	--	--	--	--	--	--	--	X	X			
	Knightville	e.	18	MA	3-SMA-1	--	--	--	--	--	--	--	X	X			
	Surry Mt.	e.	28	NH	3-SMA-1	--	--	--	--	--	--	--	X	X			
	N. Hartland	e.	38	VT	2-SMA-1	--	--	--	--	--	--	--	X	X			
	N. Springfield	e.	58	VT	3-SMA-1	1-SMA-1	--	--	--	--	--	--	X	X			
	Townsend Lake	e.	42	VT	3-SMA-1	--	--	--	--	--	--	--	X	X			

* One SMA was temporarily disconnected because of its proximity to a construction site.
 ** One SMA was damaged beyond repair by explosion and flooding.

Figure B-1 - continued.

Division	District	Project	Type (1)	H (m)	State	Accelerographs		Seismoscopes		Peak Accel.		Serviced By		
						Operational	Planned	Oper.	Plan.	Oper.	Plan.	USGS	WES	
NAD	Baltimore	Arkport	e.	36	NY	--	2	--	--	--	2	--	--	
	New York	Waterbury	e.	48	VT	--	3	--	--	--	1	--	--	
		Wrightsville	e.		VT	--	3	--	--	--	1	--	--	
SAD	Norfolk	Gathright	r.f.	78	VA	4-RFT-350	--	2	--	--	--	--	X	
	Jacksonville	Buckman Lock			FL	1-SMA-1	---	--	--	--	--	--	X	
		Corrillos			PR	1-SMA-1	---	--	--	--	--	X	--	
	Mobile	Allatoona	Arch-gr.		66	GA	3-SMA-1	---	--	--	--	--	--	X
		Buford	e.		70	GA	2-SMA-1	---	--	--	--	--	--	X
		Walter F. George	e. & gr.		45	GA	1-SMA-1	---	--	--	--	--	--	X
		Coffeeville	e. & gr.		27	AL	1-SMA-1	---	--	--	--	1	--	X
		Carters	e. & r.f.		138	GA	3-SMA-1	---	--	--	--	--	--	X
	Savannah	Clark Hill	c. & e.		61	GA	6-SMA-1	---	2	--	2	--	--	X
		Hartwell	c. & e.		73	GA	4-SMA-1	---	1	--	2	--	--	X
R. B. Russell		c. & e.		73	SC	1-RFT-350	---	1	--	2	--	--	X	
						1-RFT-350	---	1	--	2	--	--	X	
Wilmington	John H. Kerr				VA	5-SMA-1	---	--	--	1	--	--	X	
	Philpott				VA		5	--	--	--	--	--	X	
	W. Kerr Scott	e.		45	SC	3-RFT-350	---	2	--	1	--	--	X	

(Page 4 of 4)

Figure B-1 - continued.