MONITORING PLAN (UPDATED)

MR-1 SMALL SEDIMENT DIVERSIONS

ORIGINAL: OCTOBER 21, 1992
UPDATE: JANUARY 12, 1996

Project Description

The proposed project area is located in the Balize Delta of the Mississippi River, Plaquemines Parish, Louisiana on both the Delta National Wildlife Refuge and the Pass a Loutre Wildlife Management Area (figure 1). Delta National Wildlife Refuge is a 48,000 acre refuge owned and operated by U.S. Fish and Wildlife Service (USFWS). Pass a Loutre Wildlife Management Area is a 66,000 acre wildlife area owned and operated by Louisiana Department of Wildlife and Fisheries (LDWF). Seven sediment diversions will be constructed within Delta National Wildlife Refuge, off Main Pass, Octave Pass, Delta Pass, Raphael Pass, and Pass Bienvenue. An additional six diversions will be constructed within Pass a Loutre Wildlife Management Area, off Pass a Loutre, Dennis Pass, and Cheneire Pass.

The Balize Delta is located south of Venice, Louisiana. It is the seventh in a sequence of eight major delta lobe complexes formed by the Mississippi River within the past 7,500 years and it is situated between two formerly active delta lobes, St. Bernard to the east and Lafourche to the west (Frazier 1967). Formation of the Balize Delta initiated approximately 400 years ago through channel switching and bifurcation processes which resulted in several small overlapping delta lobes (subdeltas) within the Balize Delta. The natural tendency is for the Mississippi River to enter the abandonment phase of the transgressive deltaic cycle, which would cause the Balize Delta to erode into a barrier island system (figure 2), and to form a new active delta via the Atchafalaya River, a more efficient route (Fisk 1952). However, this delta-switching process has been prevented by the construction of artificial levees beginning in 1927 and by the extensive rock-reinforcement of those levees throughout the past few decades.

When the Mississippi River levees were reinforced with stone, the primary objective was flood control and prevention. However, shallow gaps were left in the river bank armor to allow overflow of freshwater during periods of high river stages and naturally occurring levee breaches (crevasses). Crevasses promote infilling of shallow interdistributary ponds with sediment-laden river water and eventually create subaerial land (or a deltaic splay) that becomes colonized with marsh vegetation (figure 3). A naturally occurring crevasse splay typically has a life cycle ranging from 20 to 175 years depending on the size and angle of the crevasse, placement within the parent pass, water discharge, sediment volume, and wind and tidal influences (Wells and Coleman 1987).

It is hypothesized that human alterations to the Mississippi River have caused negative consequences for the hydrologic cycle of the Mississippi River and its wetland-building processes.

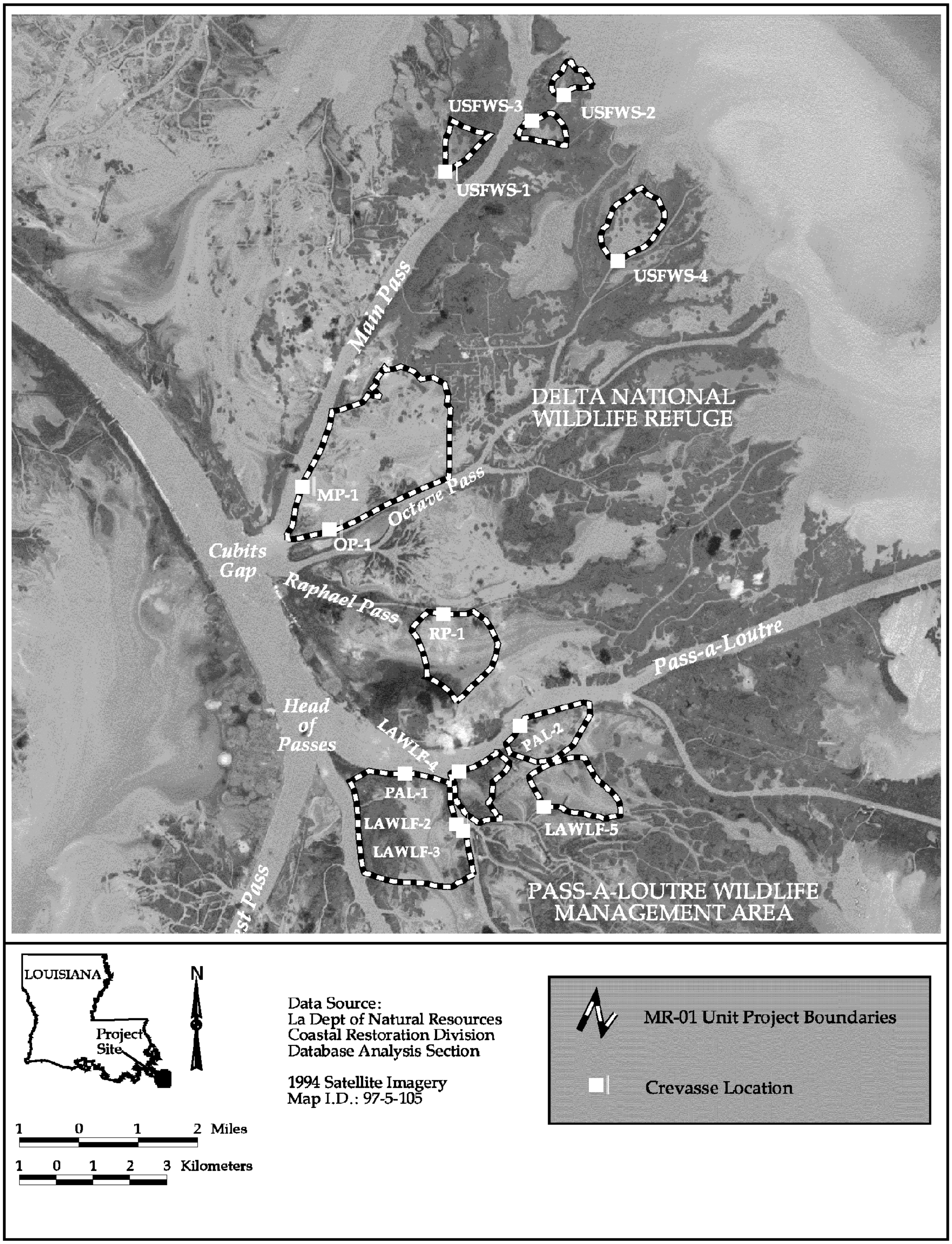

Figure 1. Small Sediment Diversions (MR-01) project area and locations of constructed crevasses.

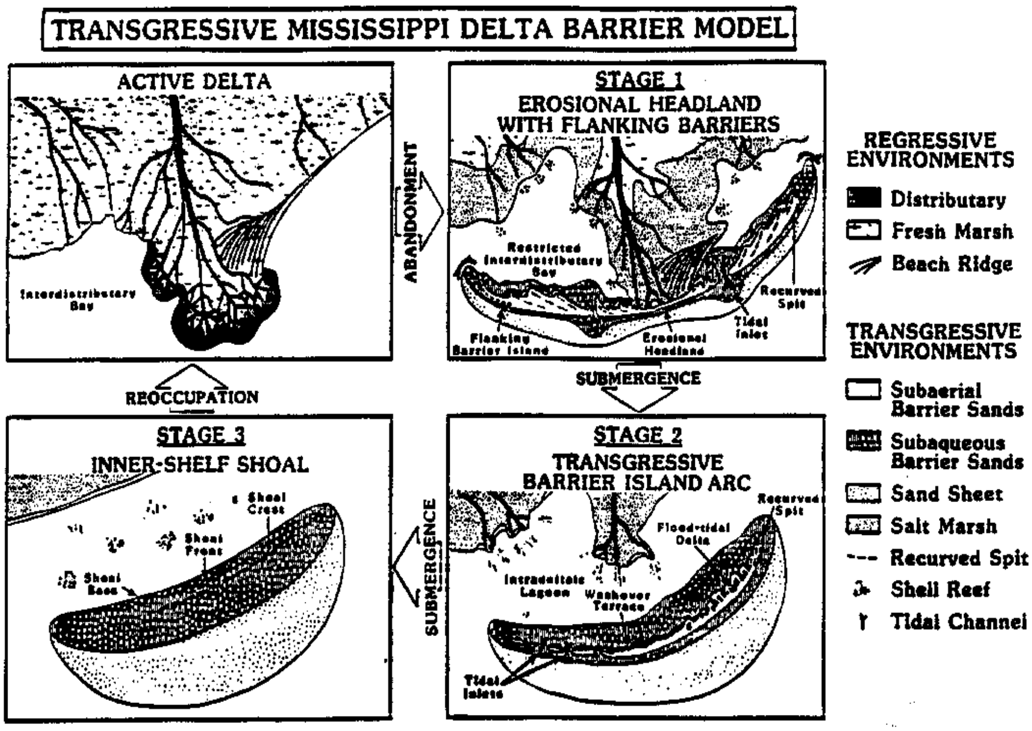

Figure 2. The genesis and evolution of transgressive depositional systems in the Mississippi River delta plain (Penland et al 1988).

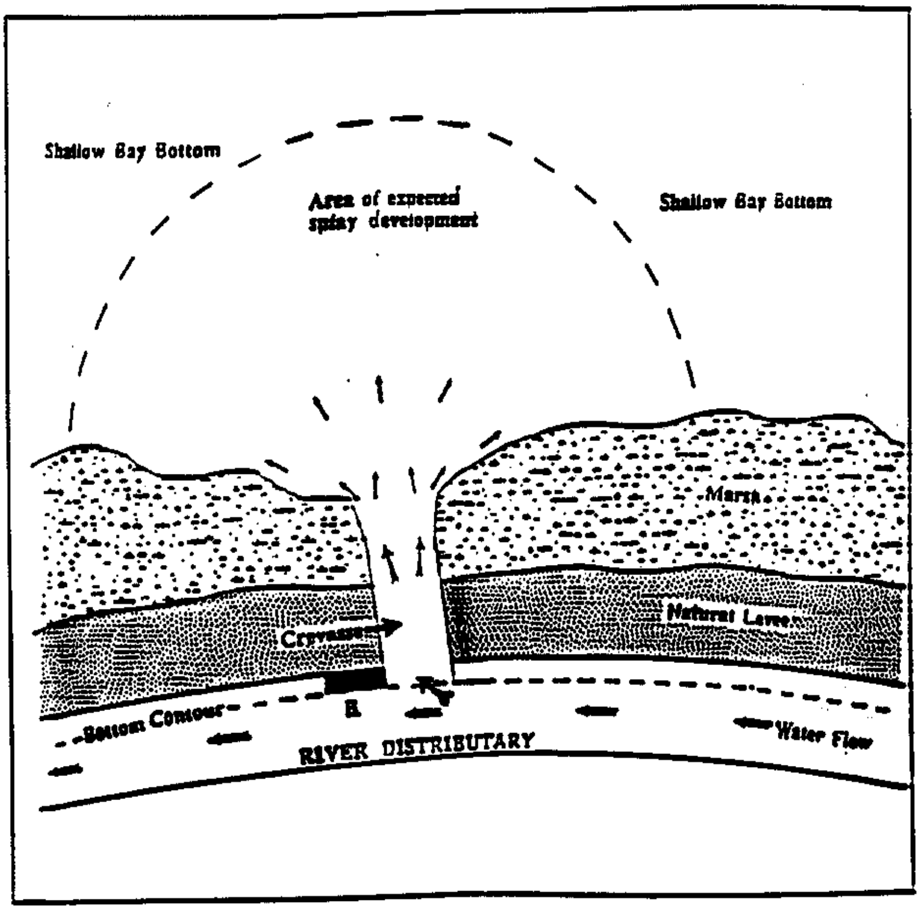

Figure 3. Schematic diagram of the artificial crevasse splay construction through a controlled breach of a distributary channel levee.

Firstly, prolonged maintenance of the river in its present location through artificial levees has caused rapid sedimentation onto the continental shelf and seaward progradation of the river mouth at rates up to 100 m/yr within the past several decades. This rapid sediment deposition coupled with gas formation (production of methane gas through bacterial decomposition of abundant organic matter) and wave loading (conversion of dissolved gases to bubble phase gases, *e.g.* methane, carbon dioxide, sulfide) has created an extremely unstable delta front. Instabilities at the continental shelf edge have induced the removal of large volumes of sediment from the delta front onto the continental slope or basin floor through rotational and retrogressive slides (Coleman et al 1983). Secondly, an abundance of small, bifurcating distributaries throughout the Delta has caused a loss in the stream gradient that is critical to efficient sediment delivery. Growth of the Delta has therefore not been limited by the size of the receiving basin, but by inefficient sediment delivery. In addition, research shows that the Mississippi River currently delivers 50 to 60 percent less sediment to the Gulf of Mexico than it did in the early 1900's. Much of this sediment loss has been due to trapping of coarse sediment material, which is essential in building subaerial land, by upstream engineering structures such as dams and resevoirs in the Arkansas, Missouri, and Ohio River basins (Wells and Coleman 1987).

Rapid wetland deterioration in the Balize Delta is likely due to a combination of the above factors, instabilities at the delta front causing massive sediment loss and inefficiency in sediment delivery, in conjunction with eustatic sea level rise. Consequently, the subsidence rate for the entire Balize Delta is approximately 0.45 in/yr (Day and Templet 1989) as evidenced by the several hundred hectares of shallow water ponds that have replaced former freshwater marshes (White 1993). Subsidence rates are further exacerbated by frequent canal dredging for navigation purposes and fluid and gas withdrawls for mineral resource mining. The most recent land loss rate estimate for the Balize Delta is 5.37 mi^2/yr which is 21 percent of the total land loss occurring in the Louisiana coastal zone (Dunbar et al. 1992).

Since the early 1980's, the method of artificially creating crevasses in the Mississippi River Delta has been tested as a management tool for combatting wetland loss. Well and Coleman (1987) found that artificial crevasses at Cubits Gap, West Bay, and Garden Island Bay subdeltas enhanced the processes of natural crevasse splay formation through breaching of the levee system and allowing sediment infilling. The Louisiana Department of Natural Resources (LDNR) constructed three crevasses in 1986 (off Pass a Loutre, South Pass, and Loomis Pass) which resulted in over 657 acres of emergent marsh from 1986 to 1991 and four crevasses in 1990 (two each off South Pass and Pass a Loutre) which produced over 400 acres of subaerial land from 1990 to 1993. The average cost per crevasse in 1990 was approximately $48,800 which translates into $433/acre of wetland created for this particular project. Several sources have recognized artificial crevasse creation as being a successful and potentially cost effective means to counteract the rapid rate of land loss in the Delta (Emmer 1968; Gagliano and van Beek 1970; Corps of Engineers 1990).

The general patterns of vegetative colonization on both naturally and artificially created crevasse splays in the Balize Delta have been well-documented. White (1993) delineates vegetation that colonizes newly emergent deltaic mudflats into three major plant communities: 1) forests of black willow (Salix nigra) establishing on upstream, high elevation islands which usually consist of the coarsest sediments, 2) communities of elephant ear (*Colocasia esculenta*) developing just downstream from the forested islands, where the finest sediments are deposited and land elevation is below mean sea level, and 3) stands of American bulrush (*Scirpus deltarum*, named for the deltaic population of *Scirpus americanus*) which develop downstream from the forested islands at intermediate elevations (between 10 cm and sea level). While the black willow and elephant ear communities develop rapidly and are usually prolific by the end of the first post-emergent growing season, the American bulrush communities typically do not become dominant until the third growing season. During the first two growing seasons, these intermediate-elevation mudflats are colonized by several of the following species of annual and perennial herbs: fall panic grass (*Panicum dichotomiflorum*), witchgrass (*Panicum capillare*), Walter's millet (*Echinochloa walteri*), sprangletop (*Leptochloa panicoides*), teal lovegrass (*Eragrostis hypnoides*), disk hyssop (*Bacopa rotundifolia*), flatsedge (*Cyperus* spp.), wand lythrum (*Lythrum lineare*), coastal arrowhead (*Sagittaria graminea*), and common arrowhead (*Sagittaria latifolia*). Although the dominant plants discussed above (black willow, elephant ear, and American bulrush) were chosen by White (1993) as representatives for each of the three community types, 62 plant species from 21 families were identified on the deltaic splays during the six years of his study, with grasses and sedges being the most common.

The main soil series common to all crevasse locations within this project is Larose. Larose soils are described as continuously flooded, deep, very poorly drained and very slowly permeable mineral clays and mucky clays. They are distributed on the fringes of fresh water marshes adjacent to the distributary natural levees of the Mississippi River at an elevation less than three feet and slope less than one percent. Since Larose soils are deposited underwater, never being air-dried or consolidated, they remain semi-fluid and highly unstable. Some additional soil series are found in conjuction with Larose soils at five of the crevasse locations within this project. Commerce and Sharkey frequently flooded soils are found at the crevasses in Main Pass and Octave Pass. These two series are grouped together because of their similarities: poorly drained and slowly permeable silt loams, silty clay loams, and fine sandy loams found on the alluvial plains of the Mississippi River and its distributaries at a slope normally less than one percent but up to five percent. Aquents, dredged and frequently flooded soils, are found at the first crevasse located in Pass a Loutre and at the two crevasses in Dennis Pass. This soil series is described as poorly drained deposited fill material that is dredged from nearby saline to slightly saline marshes. These soils are comprised of stratified layers of mucks, clays, loams, and sands, with scattered sections of shell accumulations and the upper portion typically being much firmer than the lower portion (NRCS unpublished data).

The goal of this project is to artificially create several crevasses with hopes that the diverted sediment will occupy open receiving bays and form emergent delta lobes which will eventually develop into fresh/intermediate marsh habitat. This goal will be achieved by excavating engineered breaks in the levees of several distributary channels at angles and depths that will promote large-scale sedimentation. The project outfall areas are shallow, open ponds of varying sizes and depths which are directly adjacent to the proposed crevasse locations.

The project features include:

1. Excavating thirteen crevasses of predetermined dimensions at a 60° angle from the direction of the parent pass flow, using a barge-mounted dragline and bucket or a backhoe mounted on a marsh buggy for narrow crevasses. Dimensions of the cuts will vary from 20 to 100 ft in width, 175 to 575 ft in length, and 4 to 10 ft in depth, depending on the sizes of the parent pass and the receiving bay. Table 1 illustrates the size dimensions for each proposed crevasse and its receiving bay.

Project Objective

1. Create self-sustaining emergent marsh by cutting thirteen breaches through the levees of Mississippi River distributary channels within the Balize Delta.

Measure effectiveness with data from monitoring element #	Specific Goals
	The following goals will contribute to the evaluation of the above objective:
1	1. Create crevasses at predetermined dimensions (table 1) such that sediment will be successfully transported into and retained by the selected receiving bay.
1	2. Increase the vegetated marsh:open water ratio within the project area.

Reference Area

A reference area was not selected, mainly because it would have been impractical. The project is essentially comprised of thirteen individual projects (crevasses), some of which are located great distances from one another throughout the Delta. It would therefore be difficult to establish a reference area that would represent the environmental conditions (soils, hydrology, man-made structures, tidal influences, river influences, etc.) present at all thirteen crevasses. Furthermore, it has become common practice for the two refuge agencies (USFWS, LDWF) to construct crevasses whenever and wherever they see the need. An area that may have been chosen by LDNR as a reference could potentially be unknowingly altered by the refuge agency within the 20-year lifespan of the project.

Table 1. Dimensions and pertinent statistics for the crevasse splays constructed in the Balize Delta during 1992-1993 (DNR Project MR-01, Small Sediment Divsersions).

CREVASSE LOCATION	**DATE CONSTRUCTED**	**DIMENSIONS W x L x D (ft)**	**SEDIMENT EXCAVATED (yd^3)**	**RECEIVING BAY AREA (acres) AND ORIENTATION***
Main Pass (MP-1)	January 1992	90 x 317 x 10	6,300	419 open
Octave Pass (OP-1)	January 1992, Dredged Sept. 1993	50 x 275 x 6	9,798	184 open
Raphael Pass (RP-1)	January 1992	40 x 250 x 8	1,850	110 open
Pass a Loutre (PAL-1)	August 1986, Dredged Sept. 1993	390 x 780 x 8	3,334	3,178 semi-enclosed
Pass a Loutre (PAL-2)	April 1990, Dredged Sept. 1993	300 x 1400 x 6	2,305	93 open
Dennis Pass (LAWLF 2)	September 1993	50 x 340 x 6	3,531	154 semi-enclosed
Dennis Pass (LAWLF 3)	September 1993	50 x 400 x 6	4,500	205 semi-enclosed
Pass a Loutre (LAWLF 4)	September 1993	75 x 858 x 6	7,168	88 semi-enclosed
Cheneire Pass (LAWLF 5)	September 1993	50 x 75 x 6	19,258	192 open
Octave Pass (USFWS 1)	September 1993	100 x 175 x 6	12,611	217 semi-enclosed
Delta Pass (USFWS 2)	September 1993	50 x 275 x 6	9,095	64 semi-enclosed
Delta Pass (USFWS 3)	September 1993	100 x 575 x 6	9,095	42 enclosed
Pass Bienvenue (USFWS 4)	September 1993	100 x 250 x 10	9,536	143 semi-enclosed

*Open=receiving bay has several direct hydrologic connections to the Gulf of Mexico.
Semi-enclosed=receiving bay has only one or two small connections to the Gulf of Mexico.
Enclosed=receiving bay has no outlet or hydrologic connection to the Gulf of Mexico.

Additional Monitoring Needs

1. Elevational transects may be surveyed to document the development of marsh habitat.

Monitoring Elements

1. Aerial Photography- To document the expression of subaerial land and vegetated and non-vegetated areas, color infrared aerial photography (1:12,000 scale) will be obtained immediately following completion of construction in 1993 and in post-construction years 1999 and 2011.

Anticipated Statistical Tests and Hypotheses

1. Pre- and post-construction aerial photographs will be analyzed with GIS for quantification of newly created emergent land. In addition, characteristics and success/failure rates will be compared among the thirteen crevasses. If any anomalies are discovered, elevation surveys may be conducted so that a particular crevasse and its surrounding environmental conditions may be assessed.

NOTE: Available ecological data, both descriptive and quantitative, will be evaluated in concert with all of the above data to aid in determination of the overall project success.

Notes

1.	Planned Implementation:	Start construction	August, 1993
		End construction	September, 1993
2.	DNR Project Manager:	George Boddie	342-6878
	DNR Monitoring Manager:	Suzanne Kelley	342-4127

3. Near vertical color infrared aerial photographs were taken in 11/83, 12/85, 12/90 (1: 65,000 scale), and 11/93 (1:12,000 scale).

4. Previously, the individual sediment diversions were divided among two project subheadings, MR-1a and 1b. All thirteen crevasses have been reassigned (as of 7/20/95) to "MR-1 Small Sediment Diversions", the project name which is now consistent throughout CRD.

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