SECTION IV

EVALUATION OF EXISTING STORMWATER DRAINAGE FACILITIES

The characteristics of the existing stormwater drainage facilities found within the Study Area are discussed in the following paragraphs. For clarity, Section IV has been broken into four divisions, (a) Peninsular City Area, (b) West Ashley Area, (c) James Island Area, (d) Johns Island Area. The discussion includes descriptive data for the major components of each existing system together with evaluations in regard to their adequacy and/or deficiencies. For those systems which were found to be deficient improvements have been proposed and their estimated construction costs have been developed. Both the evaluation of existing systems and the development of proposed improvements have been conducted using the design basis and criteria set forth in the preceding section.

Existing System - Description

Information for existing drainage facilities on record were furnished by the Public Services Department of the City. To verify this information and to expand it into the other portions of the study area where no records exist, it was necessary to conduct field surveys on all major components of the systems. During the survey all pipe conduit and culverts 24 inches in diameter and larger, including equivalent channels and ditches, were field located and examined in detail. Data obtained consisted of location, routes, sizes, pipe material, invert elevations, and extent of siltation. Additional, but less detailed, observations of the smaller components of the system were also made, as necessary, to establish drainage area limits. The work resulted in the delineation of 182 distinct drainage areas for evaluation.

Information obtained from the field surveys and drainage area boundaries have been placed on copies of orthophoto contour maps of the study area which were supplied to Davis & Floyd, Inc. by the City of Charleston. For reference purposes, each of the drainage areas have been designated thereon with a name derived from a major street, a neighborhood designation or other prominent feature within the area. Reduced copies of the maps at a scale of 1" = 250' for a portion of the Peninsular City area, 1" = 500' for the remainder of the Peninsular City area, West Ashley area, and James Island area, and 1" = 1000' for the Johns Island area are bound herein as Appendix A.

As shown on the maps, the overall drainage systems are composed of both buried pipe conduits and open channels with culverts installed at roadway and driveway crossings. The open channel type installation is the least expensive in original capital cost and has been used in the past wherever feasible. It is the most prevalent type of drainage system in the low density residential and commercial areas in which the restriction to property access and property utilization can be tolerated. In high density areas the use of open channels is prohibited due to high land cost, and public safety.

The majority of the channels within the study area are constructed with nearly vertical sides; and, almost all have developed a protective vegetation cover. Roadway culverts are constructed of both corrugated

metal pipe and reinforced concrete pipe. The smaller size culverts are almost exclusively reinforced concrete pipe. Except for the larger size culverts installed under major highways and railroads, culverts have been installed without inlet and outlet headwalls.

For major thoroughfares provided with curbs and gutters, pipes have been installed either under the street or under or immediately adjacent to both curb lines. Inlets are of the side inlet curb type or cast iron grate type set flush with the gutter. For pipe installed in drainage easements, inlets consist about equally of cast iron field grate type installed flush with the ground surface and the raised box type with side inlet openings.

Sediment deposition exists in the bottoms of practically all components of the system, most notably the drainage facilities located within the Peninsular City area. The depth of deposition ranges from about 10 percent of the pipe diameter in most instances to 80 percent in extreme cases. Some improvement in system performance can accordingly be accomplished by cleaning the existing systems.

Existing System - Evaluation

All of the existing systems which were inventoried have been evaluated to determine their capacity for the design frequency storm. In order to account for the cost associated with improvements to the upstream drainage systems, the total cost for improvements to the entire watershed has been increased by 20 percent. In many cases, the deficiencies which may be present in these areas are localized and minor in nature and can be improved by cleaning the existing system and making improvements to the stormwater inlets using annual operation and maintenance funds.

In evaluating the existing drainage system, the present available capacity of each major component has been computed and compared with the corresponding estimated runoff from a storm of design intensity. The capacity of the existing system components for circular and arched pipe conduits was computed based on the assumption that the pipes are clean and provide a fully effective cross sectional area except for the brick arch conduits which exist in the Peninsular City area. The brick arch conduits cross sectional area was taken from the top of the brick arch to the existing sand elevation and the capacity for these systems was computed based on this cross sectional area because it is considered impractical to remove this sand built-up. Both the existing available capacities and the required capacities have been listed for each system and presented in Table Nos. 10 through 84.

Under design rainfall and tidal conditions, the downstream portions of many systems will be submerged and their capacities thereby reduced either directly by the tidal elevations selected for design or indirectly by storm flow backwater levels caused by such tides.

Proposed Improvements

As revealed in the referenced tables, and as expected, a large number of the existing system components are of inadequate capacity under the conditions adopted for design. For each of those facilities found to be inadequate, alternative methods for correcting the deficiency have been investigated and specific improvements recommended. Table Nos. 10 through 84 have been expanded to incorporate descriptions of the proposed improvements and estimates of their construction costs. Pertinent comments as to specific conditions and considerations involved in the evaluation and recommendation for each facility have been presented adjacent to the Tables. Aerial maps showing the proposed improvements are included as Map Sector Nos. A-1 through M-15. The location of proposed facilities is schematic in nature, and the exact location will be determined during final design. Several general comments as to procedures, objectives and factors considered in the development of the proposed improvements are presented below.

In developing the recommendations, the present configurations of the individual drainage areas are retained insofar as possible. No attempt has been made to identify existing drainage easements. The investment in the existing drainage facilities is fully recognized and these systems have been incorporated into the improved overall system wherever cost effective. Furthermore, the present characteristics of the system with respect to the use of closed pipe conduit and open channel and culvert types of construction are retained.

For channel and culvert type installations, the recommended improvements consist of increasing the cross sectional areas of the channels and culverts in their present locations and routes. For pipe conduit type installations, which cannot so readily be increased in capacity, a number of alternative solutions were considered on a case by case basis. Among these were the installation of a relief sewer either adjacent to and following the same route as the existing sewer or along an alternate route. In many cases, the recommended improvements call for a multiple pipe conduit system based upon the ground elevations and features from the aerial photo maps. During final design the installation of only one larger diameter pipe conduit system may be possible with the opposite being true for those recommended improvements which call for only one pipe conduit. Where gravity systems became impractically large for some locations in the Peninsular City area, stormwater pump stations were evaluated as alternatives. The removal and replacement of an existing conduit with one of larger capacity has been recommended only when other alternatives would result in higher costs or were impracticable for other reasons.

All of the recommended improvements outlet into one of several receiving streams, and most will require excavation within the South Carolina Coastal Council Critical Zone, for both installation and to provide a free outlet. Steps must be taken to obtain a permit to excavate within this area. Without channel excavations in the marsh the proposed systems will not function properly.

The costs shown in the tables were based on the unit costs listed in Table 5. They include allowances for land acquisition costs, as applicable, and for administrative expenses, engineering and contingencies.

TABLE 5

MASTER PLAN UNIT COSTS

ITEM	UNITS	UNIT COSTS (1984 Dollars)		
		Residential Area in Easement -	in Pavement	High Traffic and Business Areas
1. Pipe - Open Cut				
18" Diameter	Lin.Ft.	41	48	73
24" Diameter	Lin.Ft.	50	58	84
30" Diameter	Lin.Ft.	64	71	97
36" Diameter	Lin.Ft.	91	99	141
42" Diameter	Lin.Ft.	109	116	160
48" Diameter	Lin.Ft.	125	132	176
54" Diameter	Lin.Ft.	168	175	221
60" Diameter	Lin.Ft.	191	198	246
72" Diameter	Lin.Ft.	239	247	296
2. Box Culverts - Open Cut				
6' x 4'	Lin.Ft.	220	240	300
6' x 6'	Lin.Ft.	240	260	320
8' x 4'	Lin.Ft.	275	295	355
8' x 6'	Lin.Ft.	295	325	375
8' x 8'	Lin.Ft.	320	340	400
10' x 6'	Lin.Ft.	395	420	480
10' x 8'	Lin.Ft.	430	450	500
10' x 10'	Lin.Ft.	460	480	530
3. Force Main - Open Cut				
54" Diameter	Lin.Ft.	305		
60" Diameter	Lin.Ft.	350		
66" Diameter	Lin.Ft.	405		
72" Diameter	Lin.Ft.	460		
84" Diameter	Lin.Ft.	575		
96" Diameter	Lin.Ft.	705		

TABLE 5

MASTER PLAN UNIT COSTS

ITEM	UNITS	UNIT COSTS (1984 Dollars)
4. Pipe - Bore and Jack		
18" Diameter	Lin.Ft.	350
24" Diameter	Lin.Ft.	400
30" Diameter	Lin.Ft.	450
36" Diameter	Lin.Ft.	500
5. Pipe - Tunnel		
42" Diameter	Lin.Ft.	800
48" Diameter	Lin.Ft.	900
54" Diameter	Lin.Ft.	1000
60" Diameter	Lin.Ft.	1100
72" Diameter	Lin.Ft.	1200
84" Diameter	Lin.Ft.	1350
96" Diameter	Lin.Ft.	1600
6. Headwalls		
18"-30" Diameter Pipe	Each	2000
36"-48" Diameter Pipe	Each	3000
54"-72" Diameter Pipe	Each	4000
7. Manholes, Catch Basins Drop Inlets		
18"-30" Diameter Pipe	Each	1500
36"-48" Diameter Pipe	Each	2500
54"-72" Diameter Pipe	Each	2800
8. Channels		
Excavation	Cu. Yd.	6.00
Concrete Paving	Sq. Ft.	4.00
Rip-Rap	Sq. Ft.	3.50
Sodding	Sq. Ft.	0.40
9. Easements		
1 Acre or less	Lot	6000
over 1 Acre	Lot	12000

Major Drainage Basis

In addition to the 182 individual drainage basins, there are four major drainage basins which lie within the City of Charleston boundaries and which have been analyzed separately. These major drainage basins drain over 300 acres each and are as follows: (1) Newmarket Creek, (2) Long Branch Creek, (3) Citadel Mall Channel, and (4) Church Creek.

1. Newmarket Creek: Newmarket Creek drains a total of 304.4 acres of the Peninsular City area between I-26 on the west and the Cooper River on the east. The existing system consist of a drainage channel which commences at I-26 and runs eastward to the Cooper River, with roadway culverts at Meeting Street and Morrison Drive (see Figure 9). As is the case with all of the major drainage channels within the study area, tide elevations have a major influence upon the capacity of the existing drainage system.

Newmarket Creek serves as the outfall for three smaller drainage basins discussed in Division A of Section IV; Meeting Street North, Huger, and Runey. The present system is inadequate and replacing the existing brick arch at Meeting Street with dual 4'x6' box culverts is recommended. In addition, widening the existing channel between Meeting Street and the Seaboard Systems Railroad east of Morrison Drive to a 45' flat bottom width, and the placement of a 60" RCP parallel to the existing dual 6'x10' box culverts under Morrison Drive are required. Table 6 list a breakdown of recommended improvements and their associated cost for Newmarket Creek. The recommended improvements will require excavation within the South Carolina Coastal Council Critical Zone and will require a permit prior to construction.

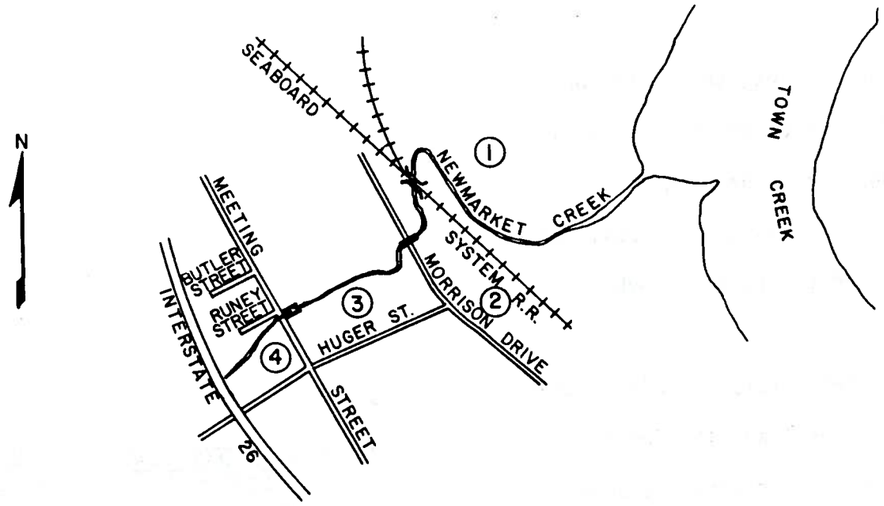
TABLE 6

HYDRAULIC ANALYSIS OF NEWMARKET CREEK

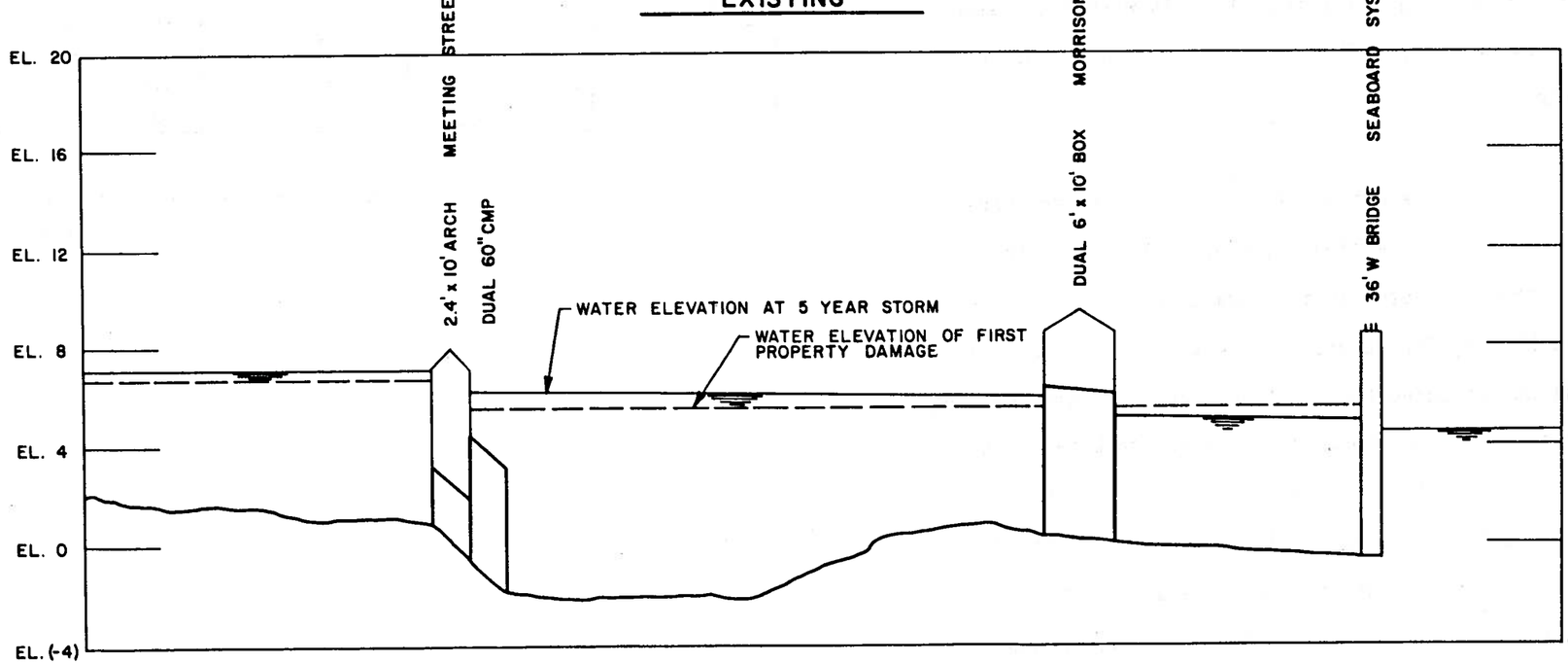
REACH NO.	DRAINAGE AREA SUBTOTAL	DRAINAGE AREA TOTAL	DISCHARGE (CFS)	EXISTING SYSTEM CONDUIT	EXISTING SYSTEM CAPACITY	RECOMMENDED IMPROVEMENTS CONDUIT	RECOMMENDED IMPROVEMENTS COST	COMMENTS
4	101.5	101.5	239	9' F.B. Channel	133	9' F.B. Channel	$ 9,000	
4-3			239	2.4'x10' Brick Arch	32	Dual 4'x6' Box Culvert	$ 55,000	Replace existing brick arch
3	194.3	295.8	680	10.5' F.B. Channel	256	45' F.B. Channel	$ 56,000	
3-2			680	Dual 6'x10' Box Culverts	690	140' - 60" RCP	$ 44,450	Parallel system
2	8.6	304.4	686	14' F.B. Channel	359	45' F.B. Channel	$ 21,600	
2-1			686	36' Wide Bridge	847		Adequate	

Subtotal	$186,050
Administrative, Engineering, Contingency	37,200
Total	$223,250

FIGURE No. 9

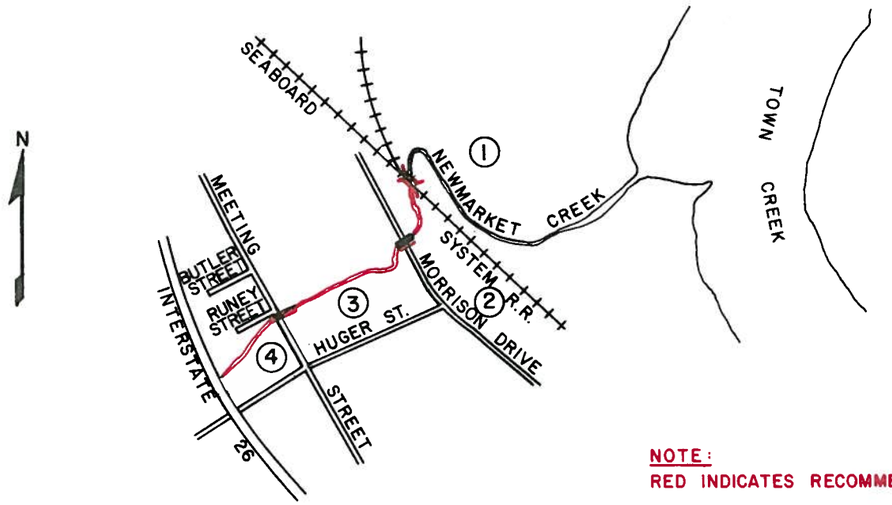


PLAN VIEW
NEWMARKET CREEK
EXISTING



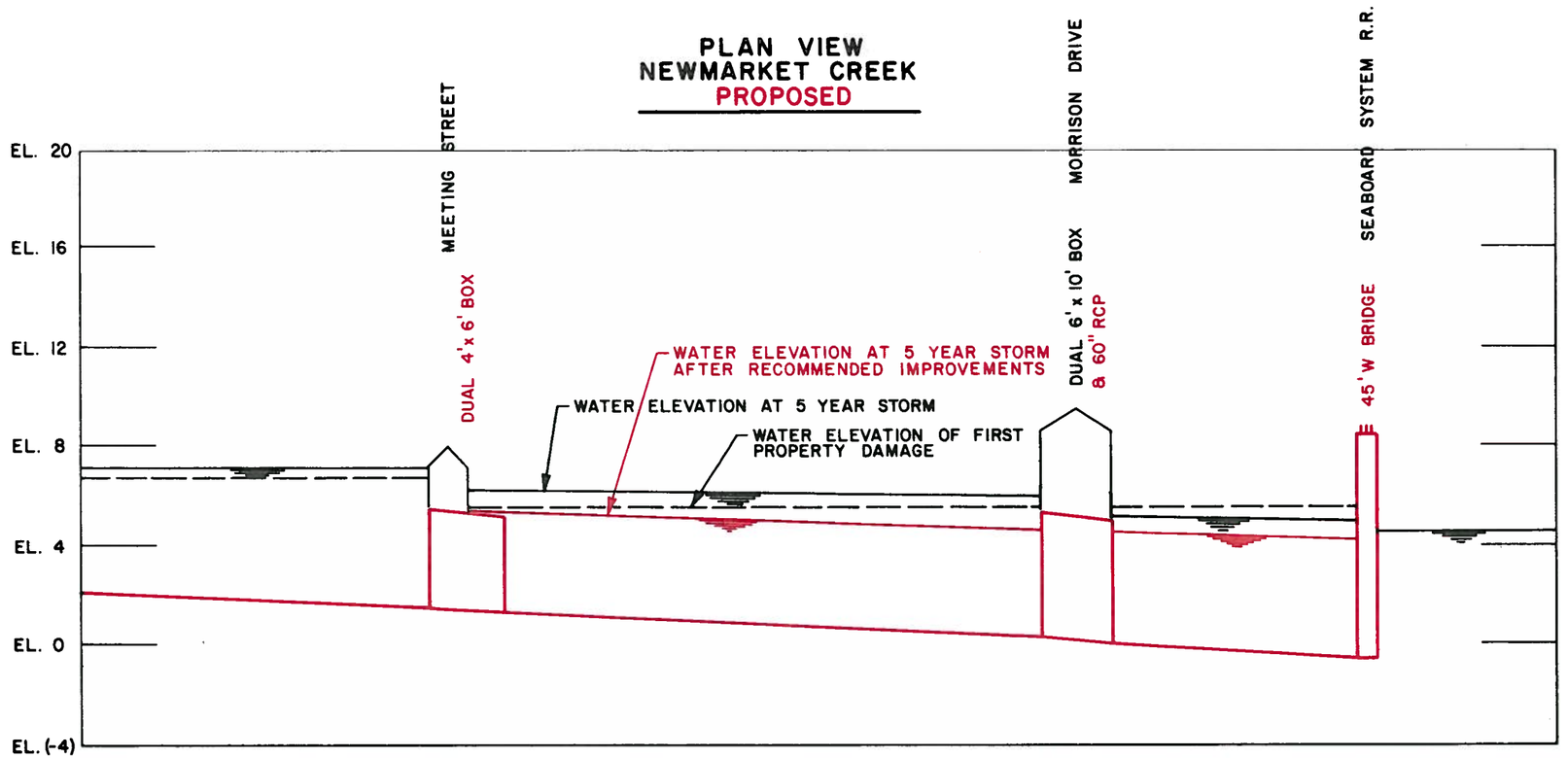
PROFILE
NEWMARKET CREEK
EXISTING

FIGURE No. 10



NOTE:
RED INDICATES RECOMMENDED IMPROVEMENTS

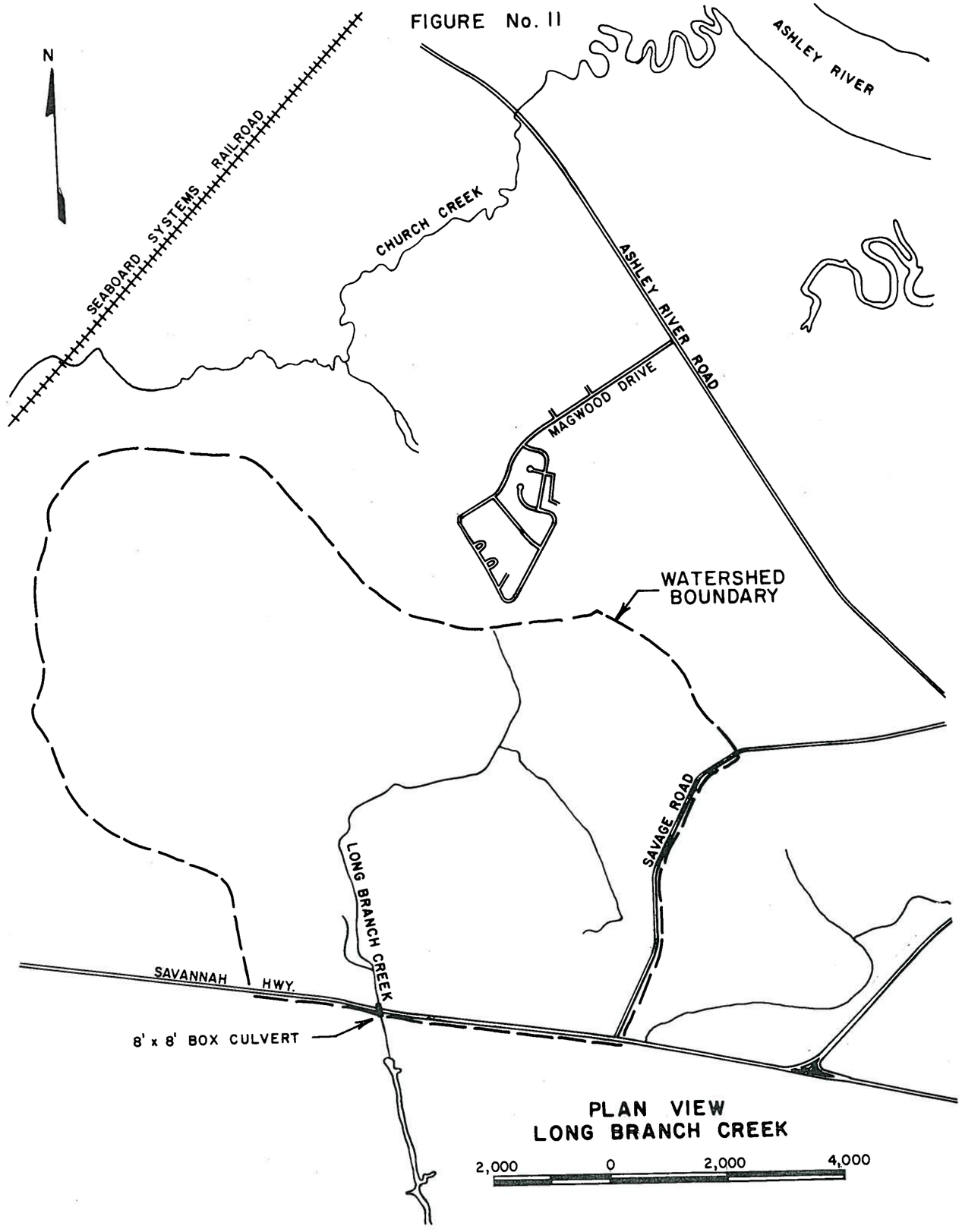
PLAN VIEW
NEWMARKET CREEK
PROPOSED



PROFILE
NEWMARKET CREEK
PROPOSED

2. Long Branch Creek: The Long Branch Creek drainage basin drains a total of 1852 acres of mostly undeveloped land lying north of U.S. Highway 17 via an 8'x8' box culvert under U.S. Highway 17. For analysis of this drainage basin, it was assumed based on the City of Charleston Land Use Plan that 70 percent of the area will be developed for either residential or apartment complex use. Based upon this assumption, the system was analyzed for the effects of a 5 year storm, and is adequate for this frequency storm provided that a total of 355 acre-feet of storage area is provided. This amount of storage area is available as presently developed, however, steps should be taken to assure that this amount of storage is provided upon completion of future development.

FIGURE No. II



3. Citadel Mall Channel: The Citadel Mall Channel drains a total of 1281 acres, with approximately 65 percent lying outside the City of Charleston boundaries. The drainage area consists of residential development in the upper reaches above U.S. Highway 7, large commercial developments in the middle reaches between Highway 7 and the Mark Clark Expressway, and mostly undeveloped land below the Mark Clark Expressway. In the past several years, there has been a rapid development of commercial areas in the middle reaches of the drainage basin, including the development of the Citadel Mall complex. The majority of these developments consist of large areas of pavement and buildings which results in increased runoff and thereby increases the probability of flooding in this area. Very few improvements have been made to the existing drainage system, with the exception of a detention basin which was built to serve the rear portion of the Citadel Mall complex.

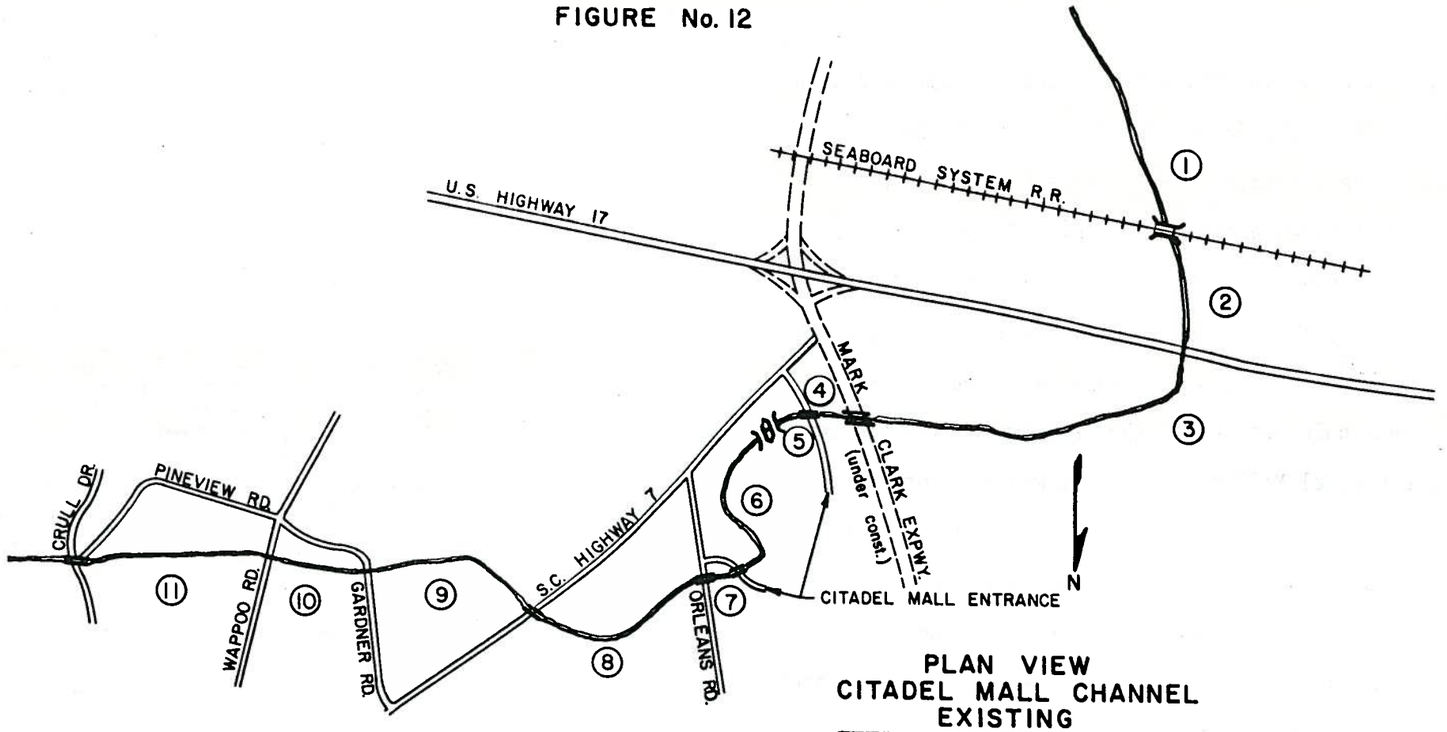
The existing drainage system is composed of a flat bottom channel with culverts at roadway crossings, (see Figure 12). The downstream portion of the channel is influenced by the effects of tide which results in decreased capacity for the system. At present, the existing drainage system is inadequate and must be improved from the Mark Clark Expressway to the upstream portion of the drainage basin. No improvements are required to either the Highway 17 or Seaboard Systems Railroad crossings, provided a total of 215 acre-feet of retention is maintained between the Mark Clark Expressway and U.S. Highway 17. As presently developed, there is adequate storage in this area, however, the City should implement steps to assure that the amount of retention area required is provided upon completion of development in the area. The recommended improvements and their associated construction cost are listed in Table 7.

TABLE 7

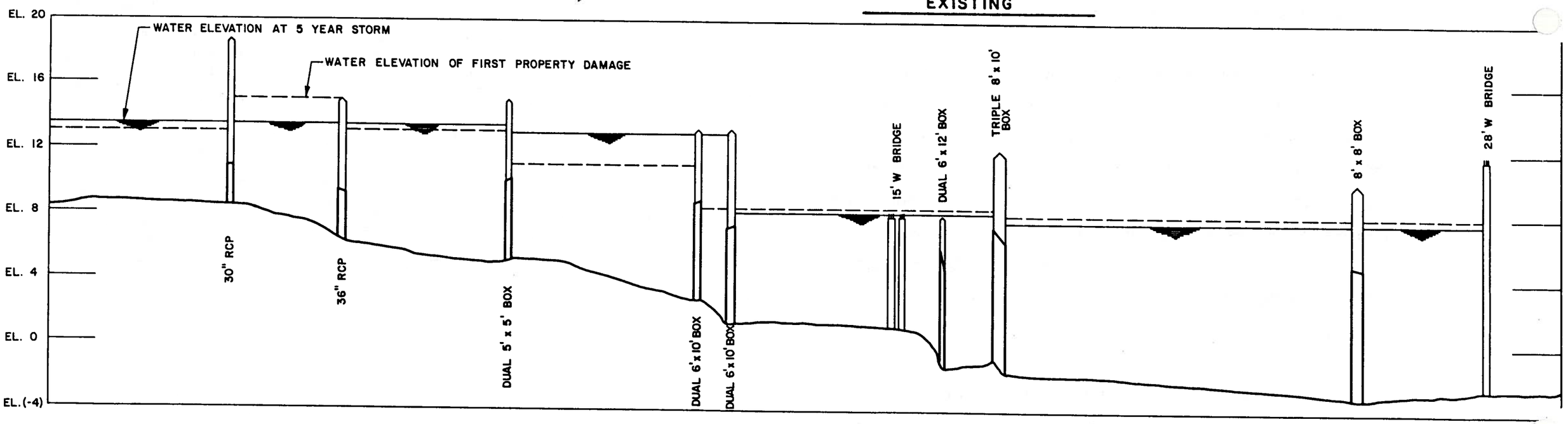
HYDRAULIC ANALYSIS OF CITADEL MALL CHANNEL

REACH NUMBER	DRAINAGE AREA (Ac.) SUBTOTAL	DRAINAGE AREA (Ac.) TOTAL	PEAK RUNOFF (cfs)	EXISTING SYSTEM STORMWATER CONDUIT	EXISTING SYSTEM DISCHARGE CAPACITY (cfs)	RECOMMENDED IMPROVEMENTS STORMWATER CONDUIT	RECOMMENDED IMPROVEMENTS COST (DOLLARS)	COMMENTS
11	113	113	367	4' F.B. Channel	20	14' F.B. Concrete Lined Channel	524,200	Possible relocation of four residences; 1/3 outside City boundary
11-10				30" RCP	24	Dual 4'x10' Box	88,000	Outside City boundary
10	47	160	465	4' F.B. Channel	62	16' F.B. Concrete Lined Channel	333,800	Possible relocation of two residences
10-9				36" RCP	37	Dual 5'x9' Box	65,400	Parallel system
9	183	343	801	6' F.B. Channel	115	28' F.B. Concrete Lined Channel	666,800	Possible relocation of four residences
9 - 8				Dual 5'x5' Box	280	Dual 5'x9½' Box	192,000	Parallel system
8	210	553	1205	8' F.B. Channel	238	47' F.B. Concrete Lined Channel	816,400	Possible relocation of two residences; 1/2 outside City boundary
8 - 7				Dual 6'x10' Box	740	Dual 6'x6½' Box	81,200	Parallel system
7	34	587	1312	20' F.B. Channel	1061	Dual 6'x6½' Box & Dual 6'x10' Box	274,000	Fill in channel & extend box culverts
7 - 6				Dual 6'x10' Box	740	Dual 6'x6½' Box	54,000	Parallel system
6	41	628	1376	15' F.B. Channel	139	54' F.B. Concrete Lined Channel	624,800	
6 - 5				15' wide bridge	805	72' Bridge	504,000	Replace existing bridge
5	140	768	1832	15' F.B. Channel	550	72' F.B. Concrete Lined Channel	144,200	
5 - 4				Dual 6'x12' Box	888	3 - 6'x8½' Box	118,000	Parallel system
4	110	878	1954	15' F.B. Channel	550	72' F.B. Concrete Lined Channel	186,400	
4 - 3				3 - 8'x10' Box	1740	72" RCP	35,200	Parallel system
3	287	1165	2053	Floodplain		215 Ac. - Ft. of of detention	Private	Detention to be provided during future development. Adequate with detention; Outside City boundaries
3 - 2				8'x8' Box	310			
2	116	1281	2203	Marsh				Adequate
2 - 1				28' Wide Bridge				Adequate with detention
						Subtotal	$4,708,400	
						Administration, Engineering, Contingency	941,700	
						Total	$5,650,100	

FIGURE No. 12

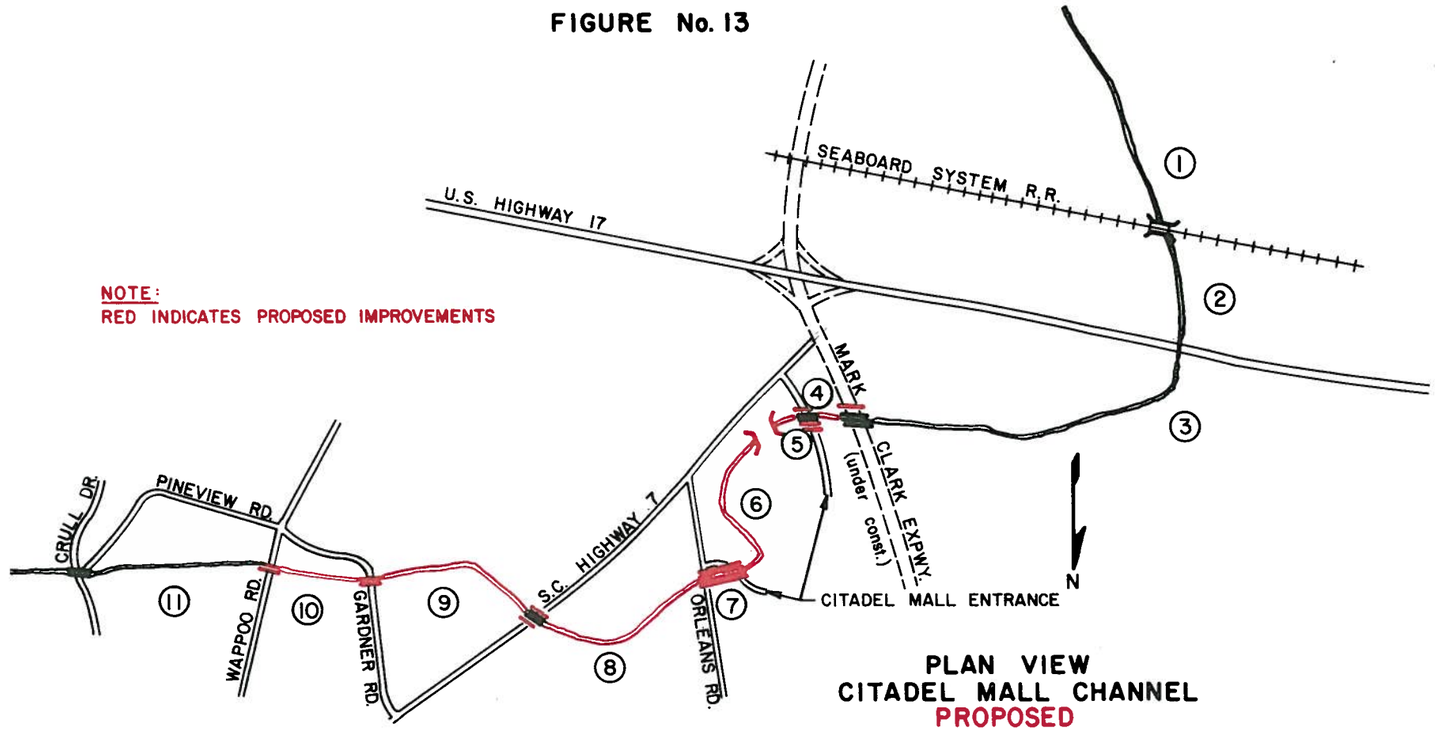


PLAN VIEW
CITADEL MALL CHANNEL
EXISTING

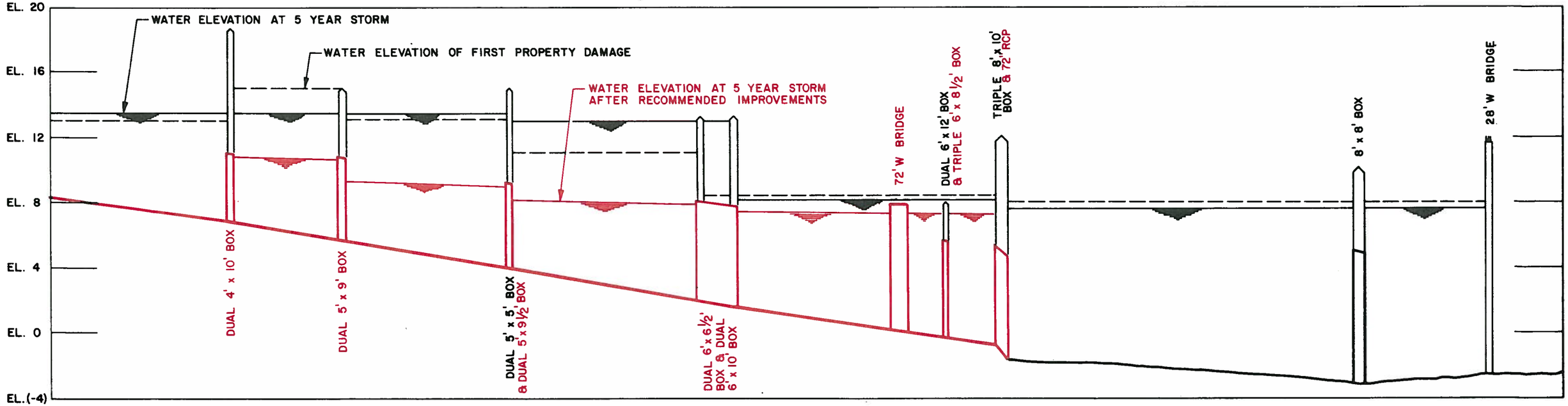


PROFILE
CITADEL MALL CHANNEL
EXISTING

FIGURE No. 13



PLAN VIEW
CITADEL MALL CHANNEL
PROPOSED



PROFILE
CITADEL MALL CHANNEL
PROPOSED

4. Church Creek: The Church Creek drainage basin drains a total of 4879 acres located along the western side of the Ashley River, and is composed mainly of old phosphate mines and marsh areas. At present about thirty percent of the total area has been developed. Development in the present city limits consist of the residential neighborhoods of Shadowmoss, Hickory Hill and Forest Lakes.

The Church Creek drainage facilities consist of a natural drainage channel and marsh area located between the outlet under U.S. Highway 61 and the Seaboard Systems Railroad. Upstream of the Seaboard Systems Railroad portions of the existing channel have been improved between Bees Ferry Road and the railroad. No improvements have been made to the existing channel upstream of the Bees Ferry crossing, with the exception of the section adjacent to the Hickory Hill Subdivision, due to the lack of development in this area. However, with development of the area, improvements to the existing channel will be required.

The peak discharge and recommended improvements for the Church Creek drainage basin are listed in Table 8. Peak discharges were computed based upon present development conditions, and the assumption that the peak discharge from future developments may not exceed the pre-development peak discharge, based upon the recommended floodplain management plan. However, it should be noted that if the recommended floodplain management plan is not implemented, the peak discharge will be increased, and as a result the existing downstream drainage facilities would then have to be enlarged.

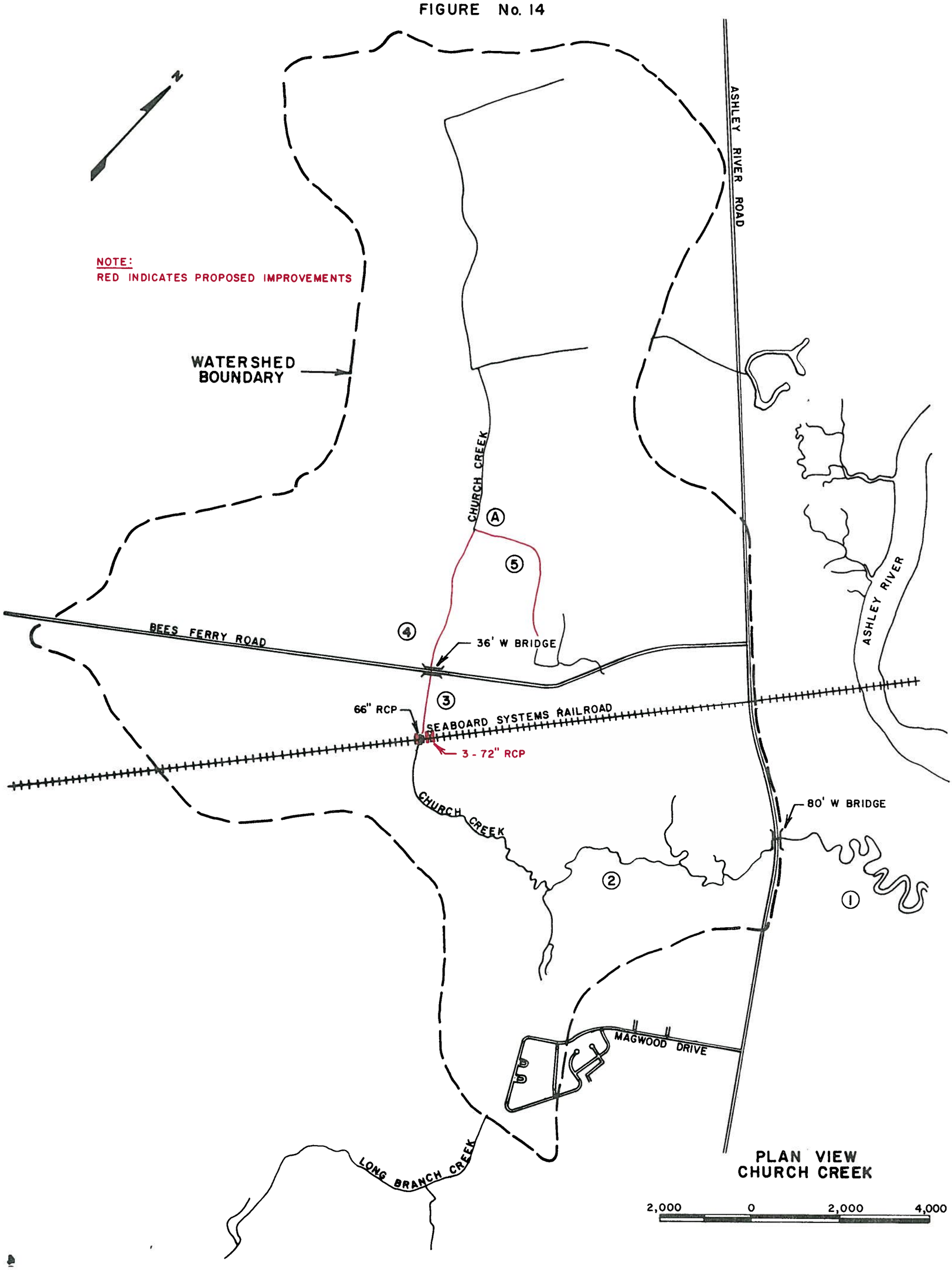
TABLE 8

HYDRAULIC ANALYSIS OF CHURCH CREEK

REACH NUMBER	DRAINAGE AREA (Ac.) SUBTOTAL	DRAINAGE AREA (Ac.) TOTAL	*PEAK RUNOFF (cfs)	EXISTING SYSTEM STORMWATER CONDUIT	EXISTING SYSTEM DISCHARGE CAPACITY (cfs)	RECOMMENDED IMPROVEMENTS STORMWATER CONDUIT	RECOMMENDED IMPROVEMENTS COST (DOLLARS)	COMMENTS
5-A	478	478	340	15' F.B. Channel	232	24' F.B. Channel	38,900	
A-4	2284	2762	621	15' F.B. Channel	232	31' F.B. Channel	162,000	
4-3				36' Wide Bridge	1688		Adequate	
3	761	3523	691	24' F.B. Channel	359	35' F.B. Channel 70' - Triple	46,800	
3-2				66" RCP	155	72" RCP	302,400	Parallel System
2	1356	4879	933	Marsh	-		Adequate	
2-1				80' Wide Bridge	3584		Adequate	
						Subtotal	$550,100	
						Administration, Engineering, Contingency	110,050	
						Total	$660,150	

*Peak discharge based on present development

FIGURE No. 14


N
NOTE:
RED INDICATES PROPOSED IMPROVEMENTS
WATERSHED BOUNDARY
ASHLEY RIVER ROAD
CHURCH CREEK
A
5
4
BEES FERRY ROAD
36' W BRIDGE
ASHLEY RIVER
3
66" RCP
SEABOARD SYSTEMS RAILROAD
3 - 72" RCP
CHURCH CREEK
80' W BRIDGE
2
1
MAGWOOD DRIVE
LONG BRANCH CREEK
PLAN VIEW
CHURCH CREEK
2,000
0
2,000
4,000