



TO: Gino Cresta, Vicky Masone | Town of Swampscott  
FROM: Mark Thompson | Kleinfelder  
DATE: September 13, 2013  
SUBJECT: Lower Paradise Road Drainage Study

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As you know, we have nearly completed the Lower Paradise Road Drainage Study, with only writing the report remaining. This Memorandum is intended to summarize the scope of work, findings, and recommendations regarding the drainage and flooding problems which have plagued the area.

### **Scope of Work Summary**

Engineering services were provided to study and recommend improvements to mitigate drainage and flooding issues in the area of Lower Paradise Road. The specific area studied is the catchment area and drain pipe network tributary to the Stacey's Brook outfall to King's Beach. The land area included in the catchment is nearly 25% of the Town's total land area. The project: (1) established existing conditions related to the drainage system in the project area; (2) collected rainfall flow metering data at target locations, which is necessary to calibrate the hydraulic model; (3) developed, calibrated, and ran a computer-based hydraulic model of the drainage system in the area; and (4) evaluated alternative improvements that could be made to the drainage system to improve or alleviate the flooding under certain storm durations and intensities. Tides were incorporated into the model.

### **Findings**

A 1-year, 24 hour, rain storm or greater, as defined by the Soils Conservation Service, results in flooding in the following sections of the project area:

1. Paradise Road near Franklin Avenue and Swampscott Avenue
2. Lower Banks Road near Farragut Road
3. Shaw Road and Elmwood Road and near Paradise Road

The model also indicates flooding will occur under the above noted conditions in the following areas beyond the immediate Paradise Road project area:

- Norfolk Avenue between Middlesex and Stetson Avenue
- Burrill Street railroad underpass
- Stetson Avenue at old railroad underpass
- Thomas Road at Walker Road



### System Improvements Evaluated

The following potential drainage system improvements, and the problem area(s) they would alleviate, were modeled:

Alt. No.	Description	Problem Areas Alleviated
A	Paradise Rd. pipe enlargement, Stacy's Brook to Franklin Ave.	1, 2, 3
B1	Supplemental pipeline in Paradise Rd., Oakledge Rd. to Banks Rd.	1
B2	Paradise Rd. pipe enlargement, Banks Rd. to Franklin Ave.	1
C	Off line stormwater storage and pumping at Abbott Park	2

The Attachment to this Memorandum provides more detail on the alternatives considered.

### Conceptual Capital Costs

The following capital cost estimates are presented for the purposes of comparing between the alternatives evaluated. These costs are considered conceptual, based on typical, recent bid prices for similar work. However, at this stage in the evaluation, there are many unknowns that may influence these costs and are likely to change during the design phase.

Note that Alternative C would have long term operation and maintenance costs associated with operating the storage tank system. These include power costs for pumping and personnel costs for operation and maintenance of the facility. These costs are not included in the estimate below at this time.

Note that the costs below include a 25% allowance for engineering and contingency.

Alt. No.	Alternative Description	Conceptual Capital Cost
A	New 4'x6' box culvert and 36" drain in Paradise Rd	\$ 4.4M
B1	Bypass the Low Point at Paradise / Franklin	\$ 750K
B2	Upsize only the 24" drain to 36" drain Paradise / Farragut Road area	\$ 820K
C	Install new 250,000 storage tank with pumping under Abbott Park	\$ 1.9M



## **ATTACHMENT – ALTERNATIVES ANALYSIS**

**LOWER PARADISE ROAD DRAINAGE SYSTEM**  
Alternatives Analysis

Table 1. Results of Alternatives Analysis for SCS 1-year, 24-hour storm simulation

Problem Area Designation	Street	Rim Elev.	ALTERNATIVES ANALYSIS RESULTS				
			Available Freeboard - Rim to WSE (Ft.)				
			Existing	A. New Paradise Rd. culvert	B1. Reroute at Franklin & Paradise	B2. Upsize drain Franklin-Banks	C. Storage near Banks Rd.
	Stetson		flooded	Flooded	flooded	flooded	flooded
	Stetson		flooded	flooded	flooded	flooded	flooded
	Stetson		flooded	flooded	flooded	flooded	flooded
	Stetson		flooded	flooded	flooded	flooded	flooded
	Norfolk	19.0	flooded	0.2	flooded	flooded	flooded
	Stetson @ RR		flooded	flooded	flooded	flooded	flooded
	Norfolk		flooded	flooded	flooded	flooded	flooded
3	Paradise/Shaw	16.0	flooded	3.6	flooded	flooded	flooded
1	Paradise/Franklin	21.5	flooded	4.1	0.3	1.9	flooded
2	Banks	18.2	flooded	3.6	flooded	flooded	0.45
2	Banks	17.9	flooded	3.6	flooded	flooded	0.42
	Thomas-Walker		flooded	flooded	flooded	flooded	flooded
	Thomas-Walker		flooded	flooded	flooded	flooded	flooded
	Thomas-Walker		flooded	flooded	flooded	flooded	flooded
	Thomas-Walker		flooded	flooded	flooded	flooded	flooded
	Burrill @ RR		flooded	flooded	flooded	flooded	flooded

NOTE: Modeled results outside the study area are shaded in grey.

## LOWER PARADISE ROAD DRAINAGE SYSTEM

### Alternatives Analysis

**ALTERNATIVE A.** Upgrade existing storm drain in Paradise to 4'x6' concrete culvert from Stacey Brook to Banks Road (2,888 LF) and 36" RCP continuing up to Paradise/Franklin (640 LF). The modeling estimates that this could eliminate flooding along the Paradise Road corridor and notably at Paradise/Franklin for storms up to the 10-year event, with only brief flooding at Paradise/Franklin during the 25-year event.

**ALTERNATIVE B1.** Reroute stormwater from upstream of Paradise/Franklin to bypass this intersection in a 24" RCP that reconnects to the existing drain in Paradise Road downstream at Paradise/Banks. The modeling estimates that this could nearly eliminate flooding at Paradise/Franklin but only at this intersection, and only for the 1-year storm event. All larger storms would still flood due to the a combination of the drainage area size, the low surface grade, and a high HGL downstream at Paradise/Banks.

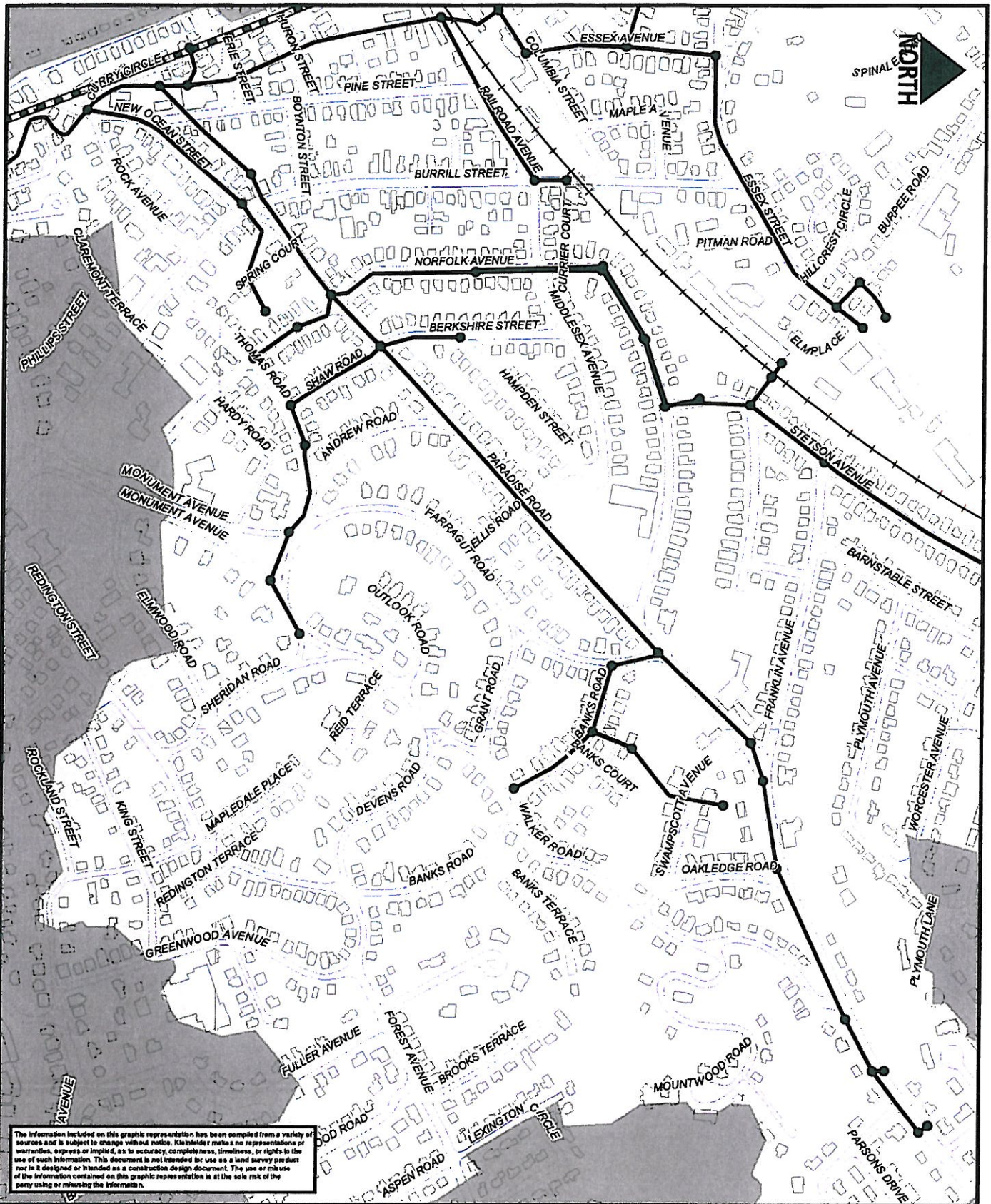
**ALTERNATIVE B2.** Upsize the existing 24" drain in Paradise between Franklin and Banks (640 LF) to a 36" RCP. The modeling estimates that this could eliminate flooding at Paradise/Franklin during the 1 and 2-year events. Brief flooding occurs at the 5-year event and worsens with larger storms. The larger pipe would need to be set lower than the existing pipe and would require at least two new deeper manholes. Flooding would still be expected on Banks and downstream due to the capacity limitation of the existing pipe in Paradise Road.

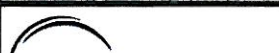

**ALTERNATIVE C.** Evaluate the benefit of providing stormwater storage at Abbott Park. We investigated several configurations of overflow pipes and storage tanks but found that even with very large storage volumes, only modest benefits were realized. The results listed are an overflow connection at Paradise/Banks. The type of storage tested is called "burp storage" because it is only activated when the water levels in the stormwater system reach a critical stage, at which point water is allowed to begin filling the storage facility. The storage peaks and begins to empty by gravity at the tail of the storm. The stored volume below the system elevation must be pumped, typically at a slow rate, to prime the storage for the next storm.

The apparent reason that this alternative does not provide much benefit is that Abbott Park is too far downstream from the main problem area (Paradise/Franklin). Even with the storage facility fully active, the 24" pipe draining Paradise/Franklin still creates a bottleneck. The result is that even by providing 250,000 gallons of storage below elevation 17.0 in Abbott Park, surface flooding is not prevented at Paradise/Franklin, only modest improvements are seen on Banks, and only minimal reduced flooding durations are experienced downstream. In order for substantial benefits from this option to be realized, pipes in Paradise upstream of Abbott Park would need to be up-sized. But the exercise of testing this alternative and considering the results from 'A' and 'B2' above, all seem to suggest that increasing capacity, rather than storing stormwater is the more effective approach. Storage is more appropriate when increasing downstream system capacity is not feasible. However, the hydraulic modeling indicates that, under normal tide conditions, the downstream reaches of the system (Stacey Brook culvert sections, and the outfall) have excess capacity.

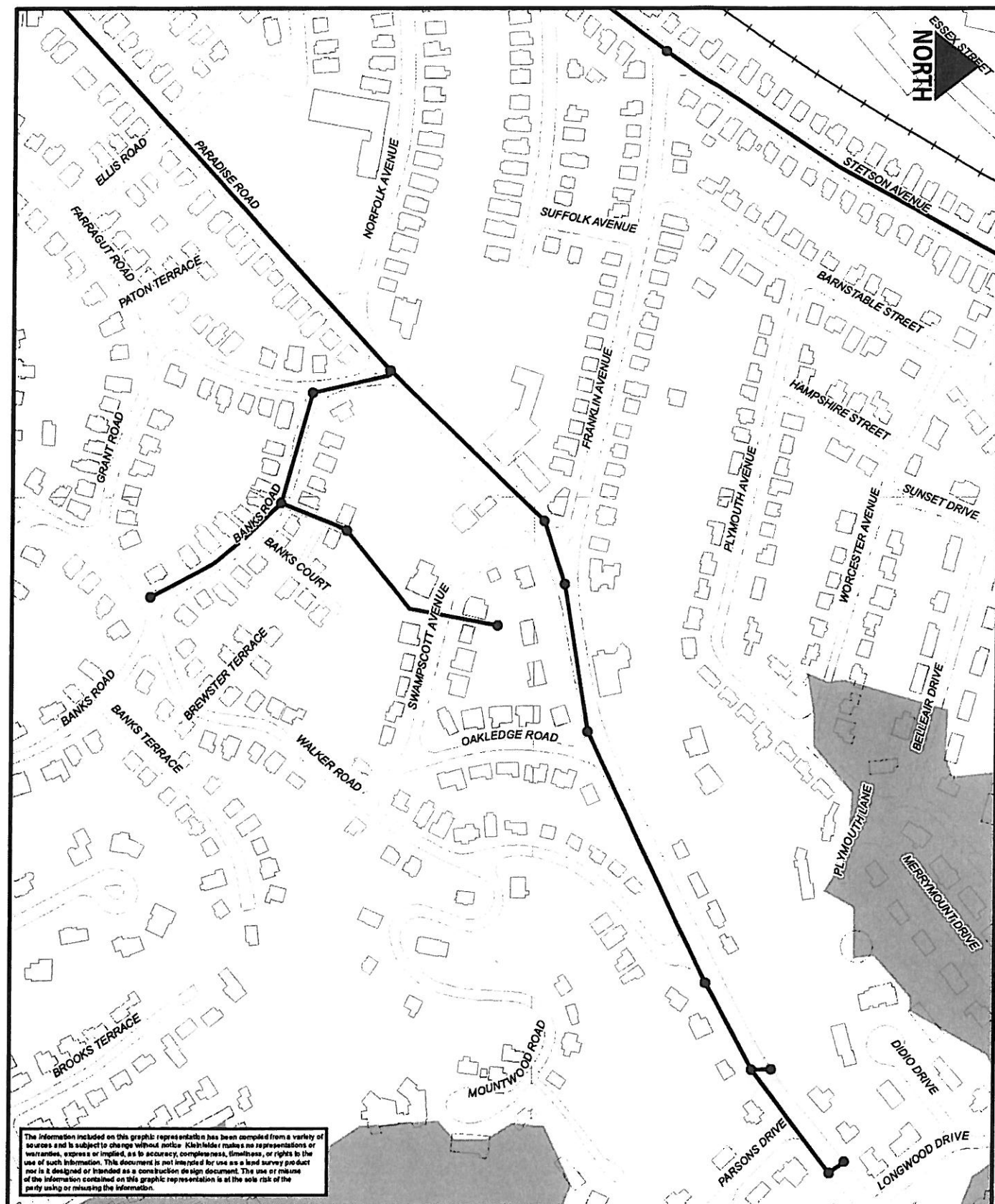
*NOTE: All results shown here reflect a 24-hour SCS Type III rainfall distribution with the peak intensity occurring roughly within 15 minutes of a high tide, and high tide elevations of approximately 4 Ft. (NAVD) as recorded in June 2013 by NOAA.*





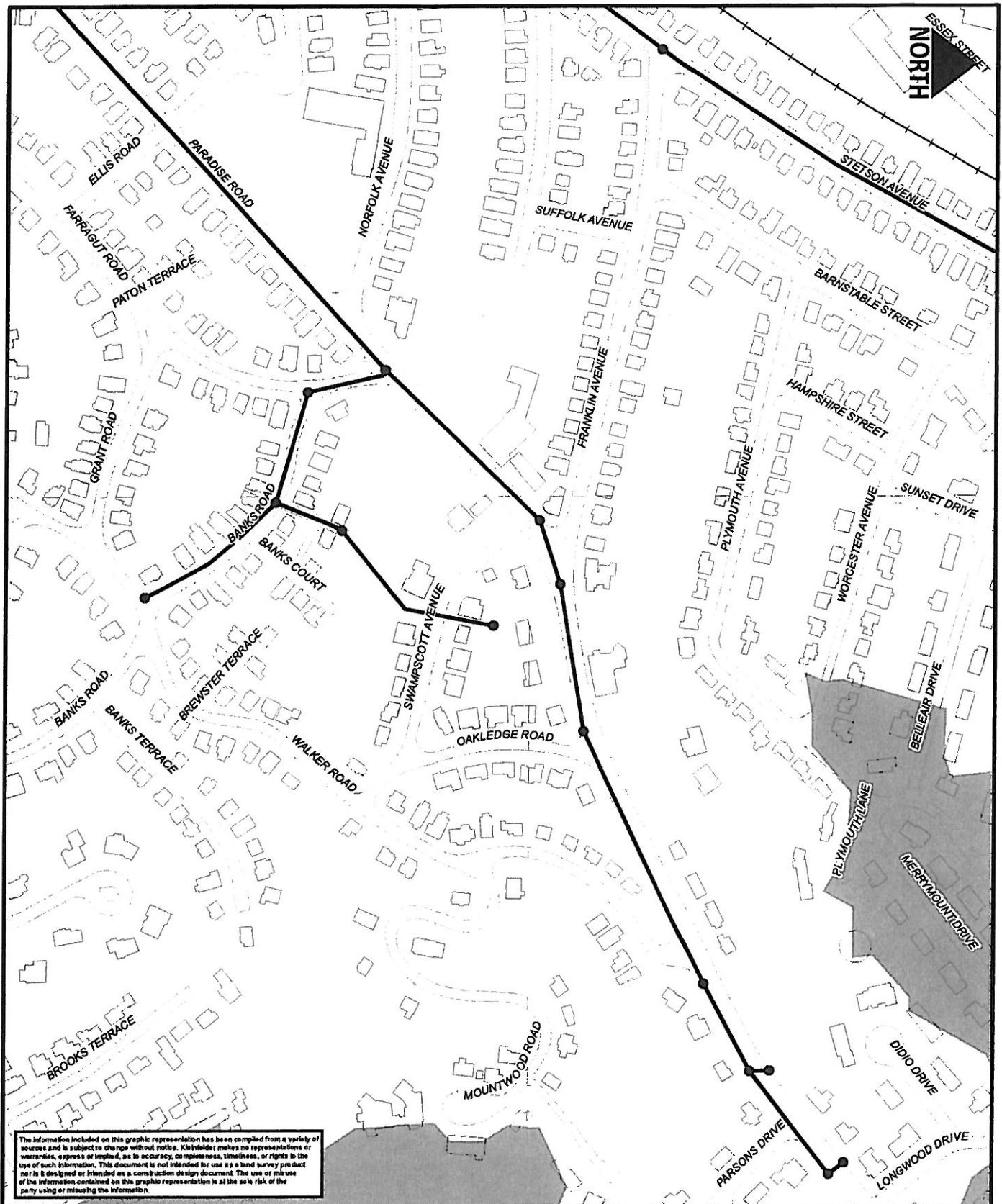




 	PROJECT NO.	20120234	<b>ALTERNATIVE A</b> <b>NEW PARADISE ROAD CULVERT</b>	FIGURE  <b>A</b>
	DRAWN:	9/13/13		
	DRAWN BY:	DTP	Lower Paradise Road Drainage Study Town of Swampscott, MA	
	CHECKED BY:	MJT		
	FILE NAME:	Figure A - Alt A.mxd		





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	DRAWN:	9/13/13		
	DRAWN BY:	DTP		
	CHECKED BY:	MJT	Lower Paradise Road Drainage Study Town of Swampscott, MA	
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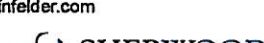


 <p>www.kleinfelder.com</p> 	PROJECT NO.	20120234	<b>ALTERNATIVE B2</b> <b>UPSIZED DRAINAGE FROM</b> <b>FRANKLIN AVE. TO FARRAGUT RD.</b>  Lower Paradise Road Drainage Study Town of Swampscott, MA	FIGURE  <b>B2</b>
	DRAWN:	9/13/13		
	DRAWN BY:	DTP		
	CHECKED BY:	MJT		
	FILE NAME:	Figure B2 - Alt B2.mxd		





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	DRAWN:	9/13/13		
	DRAWN BY:	DTP		
	CHECKED BY:	MJT	Lower Paradise Road Drainage Study Town of Swampscott, MA	
	FILE NAME:	Figure C - All C.mxd		

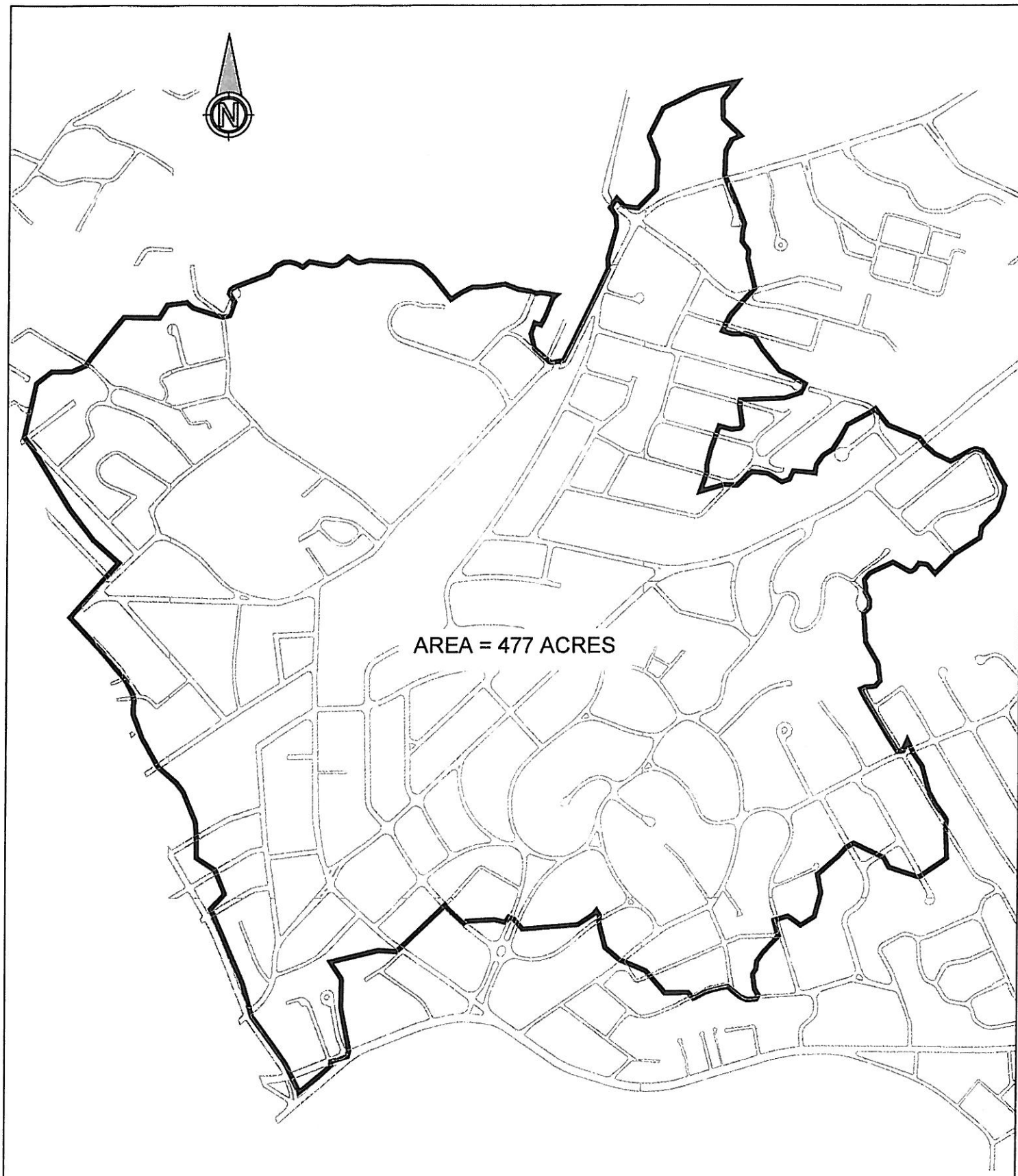
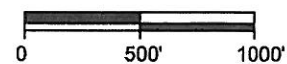


Figure 1.  
KING'S BEACH OUTFALL DRAINAGE SYSTEM  
SWAMPSCOTT, MA



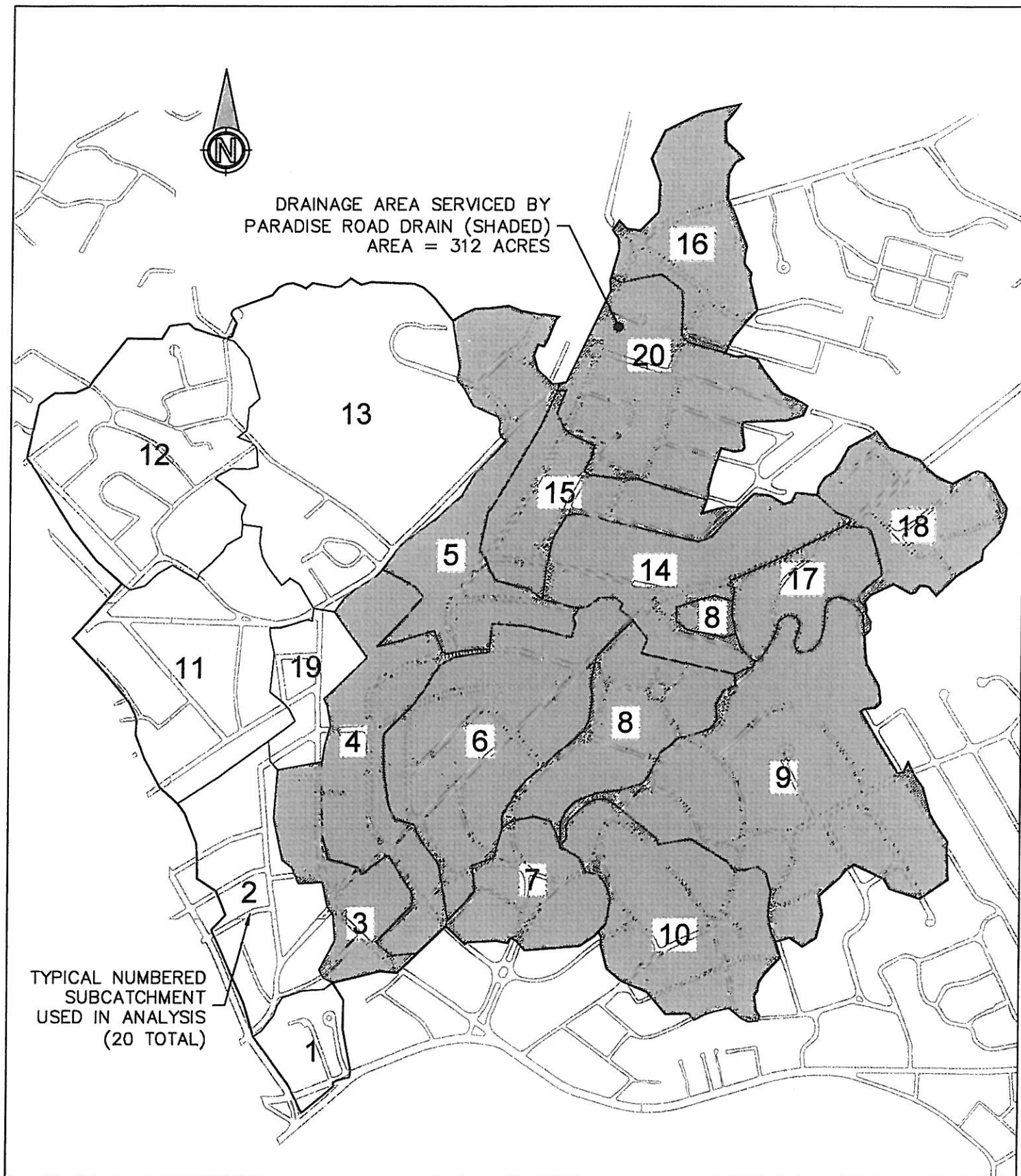


Figure 2.  
PARADISE ROAD DRAINAGE AREA  
SWAMPSCOTT, MA

