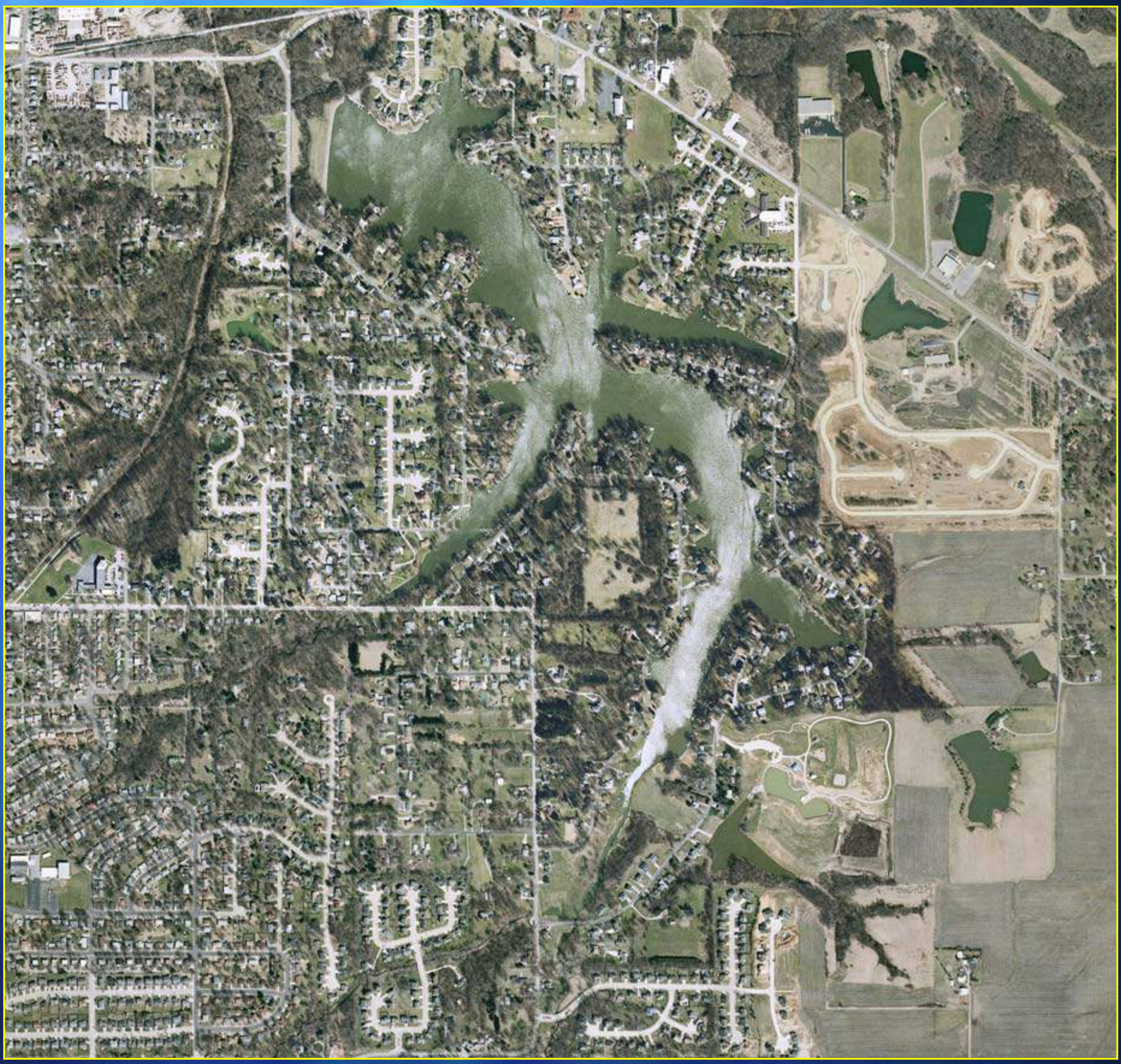
Dunlap Lake Watershed Study and Lake Management Plan

(prepared for the Dunlap Lake POA)

(Draft Submittal – 1/26/05)



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Introduction

Dunlap Lake is a 106-acre reservoir located in Madison County within the city limits of Edwardsville, Illinois. The lake is impounded by an earthen dam with a drop inlet spillway and a concrete emergency spillway channel that discharges into Mooney Creek, which is a tributary to Cahokia Creek, Cahokia Diversion Canal, and the Mississippi River. The watershed or drainage area consists of approximately 2,613 acres that is comprised of agricultural, woodland, and urban/residential land uses (Figure 1). The lake was created in 1939 to provide members of the homeowners association with fishing, boating, and aesthetic enjoyment opportunities. The lake is owned and operated by the Dunlap Lake Property Owners Association (DLPOA).

Scope of Work

The scope of work included: (1) an evaluation of historical and current lake and watershed conditions, management efforts, and local ordinances; (2) gathering necessary field data through systematic reconnaissance and field measurement; (3) assessing and evaluating the collected data in order to identify and quantify the sources and extent of sediment deposition within the lake; (4) making short and long-term projections of probable impacts to lake water quality and recreational usage; and (5) providing recommendations and estimates of probable cost of sediment and management alternatives suitable for restoring and protecting the lake.

Multiple field reconnaissance trips included a sedimentation survey of the lake to determine the extent and severity of sediment deposition, and an evaluation of upstream conditions in the watershed to identify sources of excessive soil erosion. The results of the sedimentation survey and the field reconnaissance trips within the watershed were used to develop this report, which presents options for reducing future sediment inputs to the lake and excessive amounts of sediment within the lake.

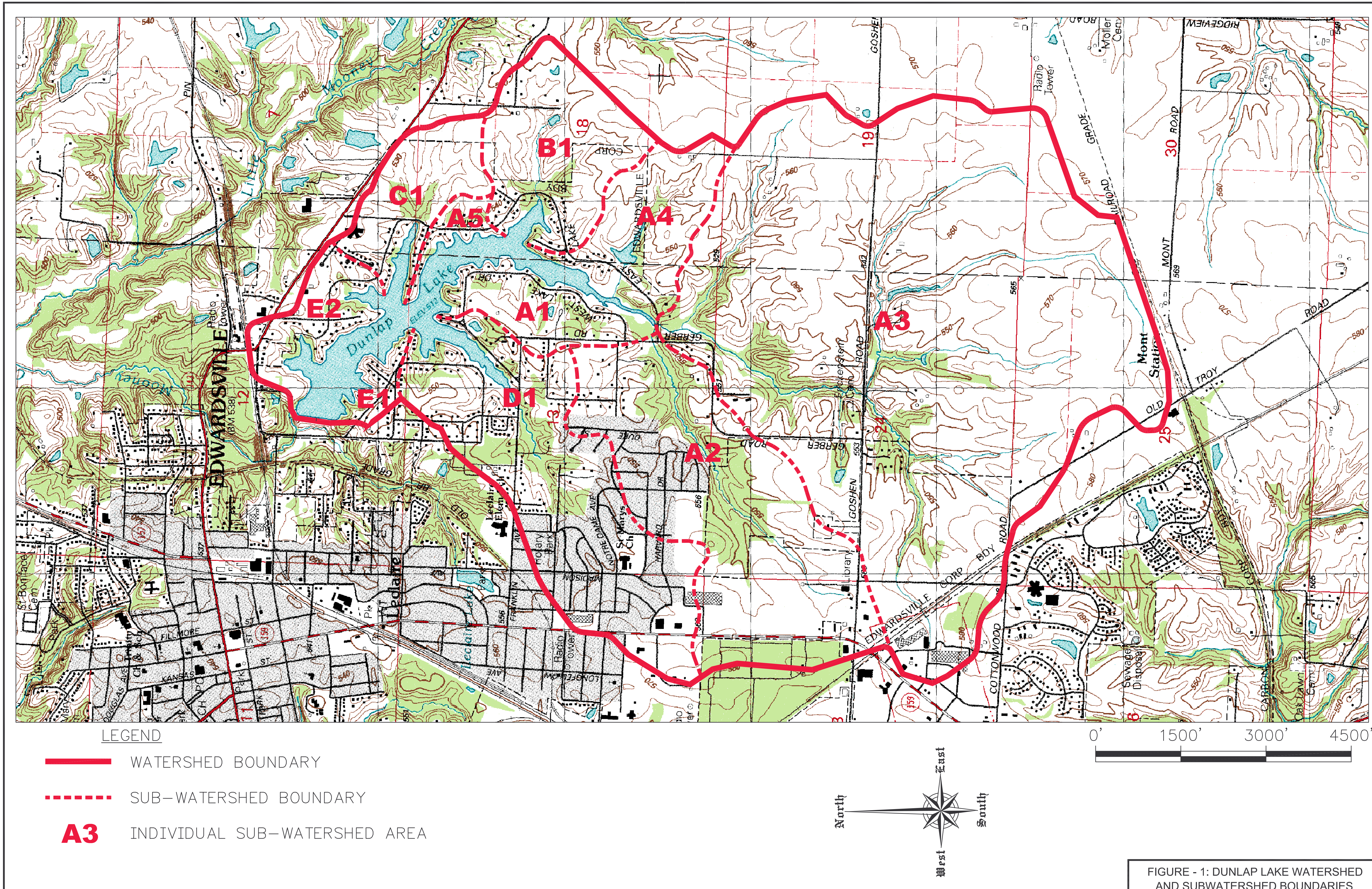


FIGURE - 1: DUNLAP LAKE WATERSHED AND SUBWATERSHED BOUNDARIES

Description of Lake Management Efforts

The DLPOA has implemented various lake management measures that have included periodic mechanical and hydraulic dredging, imposing a 9.9-horsepower limit on all boat motors used on the lake, requiring lake front residents to install some form of shoreline stabilization and protection measures, and cooperatively working with the City of Edwardsville to strengthen the language and enforcement provisions within the city's erosion control ordinance. In addition to these lake management efforts, the DLPOA received assistance from the Madison County Soil and Water Conservation District and the District 1 Engineer for the USDA-NRCS to design a sedimentation basin for the south end of the lake. However, no effects to construct the basin have been initiated.

Various dredging activities have been completed between 1993 and 2000. An estimated 60,000 cubic yards of accumulated sediment were hydraulically dredged from Dunlap Lake in 1993 at a cost of $250,000 ($322,000 with accrued interest.) In 1996-97, three sediment control "ponds" at the south end of the lake were mechanically excavated. By 1999, it was observed that these "ponds" had filled in with sediment and water depths had been reduced. Therefore, additional excavation efforts were completed in 1999. According to DLPOA records, these historical dredging efforts removed an estimated 106,200 cubic yards of accumulated sediment at a combined cost of $389,900. Horsepower limits and no wake areas, combined with shoreline stabilization requirements have contributed to reduced wave action and bank erosion in an effort to minimize sediment loadings to the lake. The existing sediment control "ponds" at the south end of the lake have a reported sediment trap/removal efficiency of less than ten percent and are apparently undersized for the size of drainage area or watershed that flows through them. In 1996, the adjacent grassy area west of the creek area was delineated as a jurisdictional wetland and was deemed to be "waters of the United States." This wetland area could be dredged, cleared or constructed upon with approval from the Army Corps of Engineers. Therefore, the DLPOA requested technical support from the USDA-NRCS District Engineer to design a larger, more effective sedimentation basin at the south end of the lake in order to minimize future sediment deposition.

Description of Watershed

For most of the lake's sixty-five year history, the largest percentage of the lake's approximate 2,613-acre watershed has been agricultural in nature. However, past and current development in the Dunlap Lake watershed has transformed the dominant land use type from agricultural to urban or residential/commercial. These major land use changes within the Dunlap Lake watershed were documented by the DLPOA and confirmed by CWI using aerial photography, field reconnaissance and Geographical Information Systems (GIS) software. The primary land use types were divided into four major categories, which included: agricultural, urban, woodland, and water. Three-watershed land use maps were developed by DLPOA for the years 1956, 1998, and 2004 (Figures 2, 3, and 4).

CWI has delineated the approximate 2,613-acre Dunlap Lake watershed and then further divided it into ten (10) separate sub-watersheds. Figure 1 and Table 1 illustrate the locations and lists the physical area in acres of the lake and its sub-watersheds. The water surface area of the lake accounts for approximately 4.1 percent of the total watershed area. Sub-watersheds A-1 through A-5 border and impact the southern two-thirds of the main body of the lake. These sub-watersheds make up approximately 1,841 acres or 70.5 percent of the watershed. The other sub-watersheds (i.e., B-1 at 159 acres, C-1 at 92 acres, D-1 at 327 acres, and E-1 and E-2 at 88 acres) drain land areas that feed into several smaller inlets or bays on the lake. These smaller sub-watersheds collectively make up the remaining 25.4 percent of the watershed. Sub-watershed designations were based on the sub-areas of the lake assigned for the sedimentation survey. The sub-watershed land areas and associated land uses were utilized to evaluate historical and current impacts to the lake, as well as potential future impacts.

Table 1. Dunlap Lake Sub-Watershed Areas

Sub-Watershed Designation by Lake Sub-Area	Drainage Area (Acres)	Percentage of Total Watershed Area
	Lake Sub-Area A	
A-1	78	2.97%
A-2	379	14.52%
A-3	1,248	47.77%
A-4	117	4.49%
A-5	19	0.72%
Subtotal A	**1,841**	**70.46%**
	Lake Sub-Area B	
B-1	159	6.07%
Subtotal B	**159**	**6.07%**
	Lake Sub-Area C	
C-1	92	3.51%
Subtotal C	**92**	**3.51%**
	Lake Sub-Area D	
D-1	327	12.53%
Subtotal D	**327**	**12.53%**
	Lake Sub-Area E	
E-1	20	0.77%
E-2	68	2.60%
Subtotal E	**88**	**3.37%**
	Dunlap Lake (Water Surface Area)	
Lake	106	4.06%
Subtotal Lake	**106**	**4.06%**
Total Watershed Area	**2,613**	**100.00%**

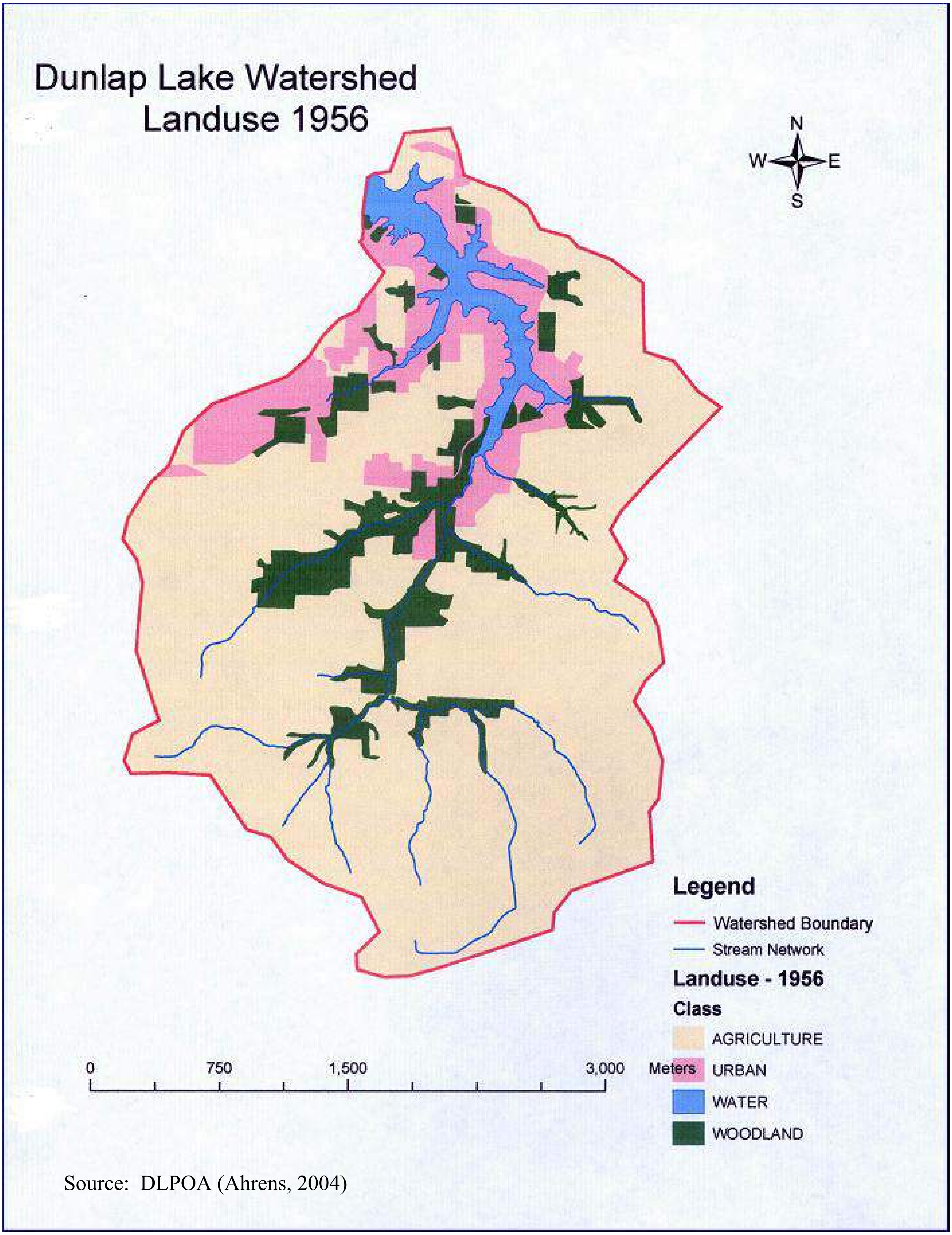


Figure 2. Watershed Land Use Map - 1956

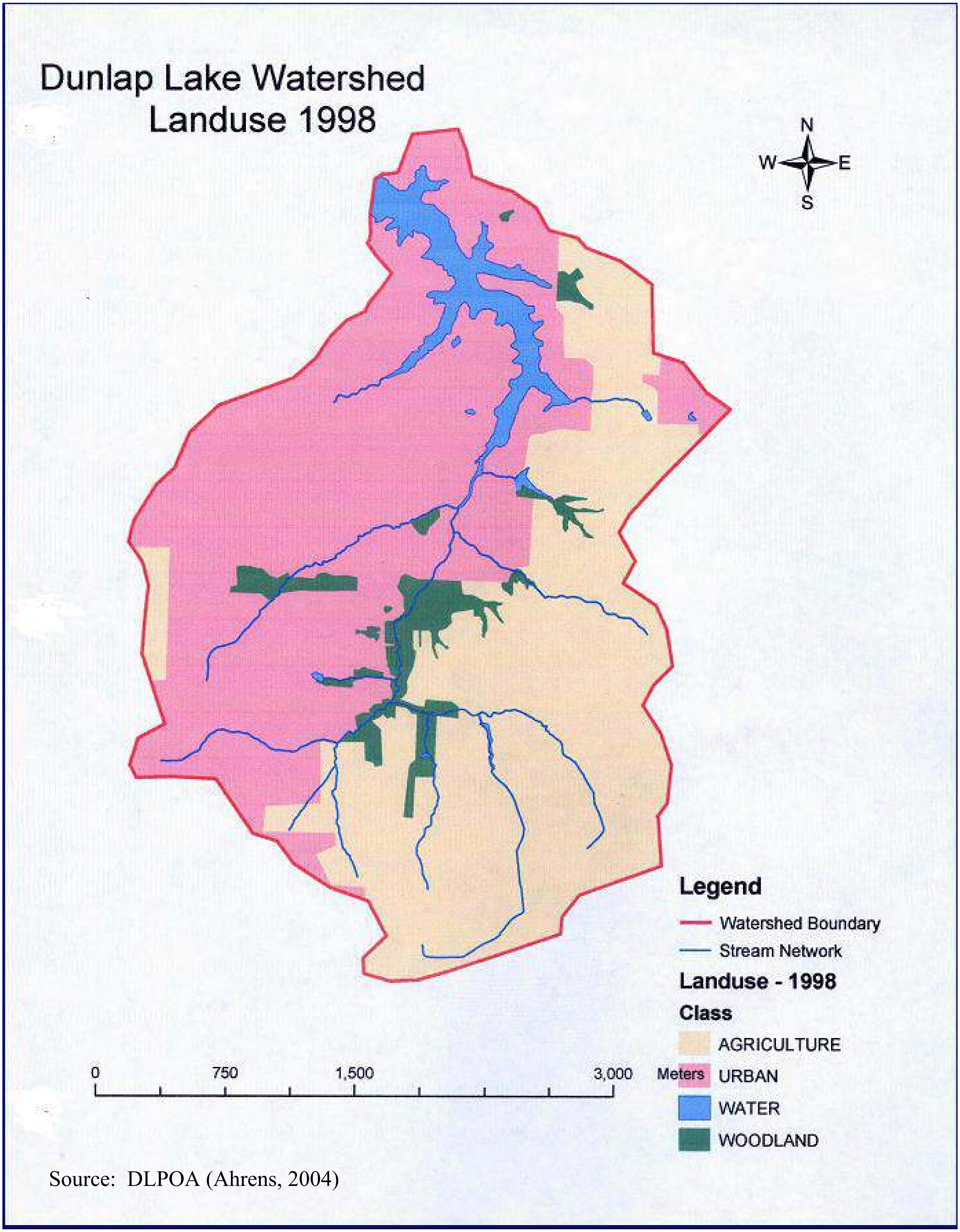
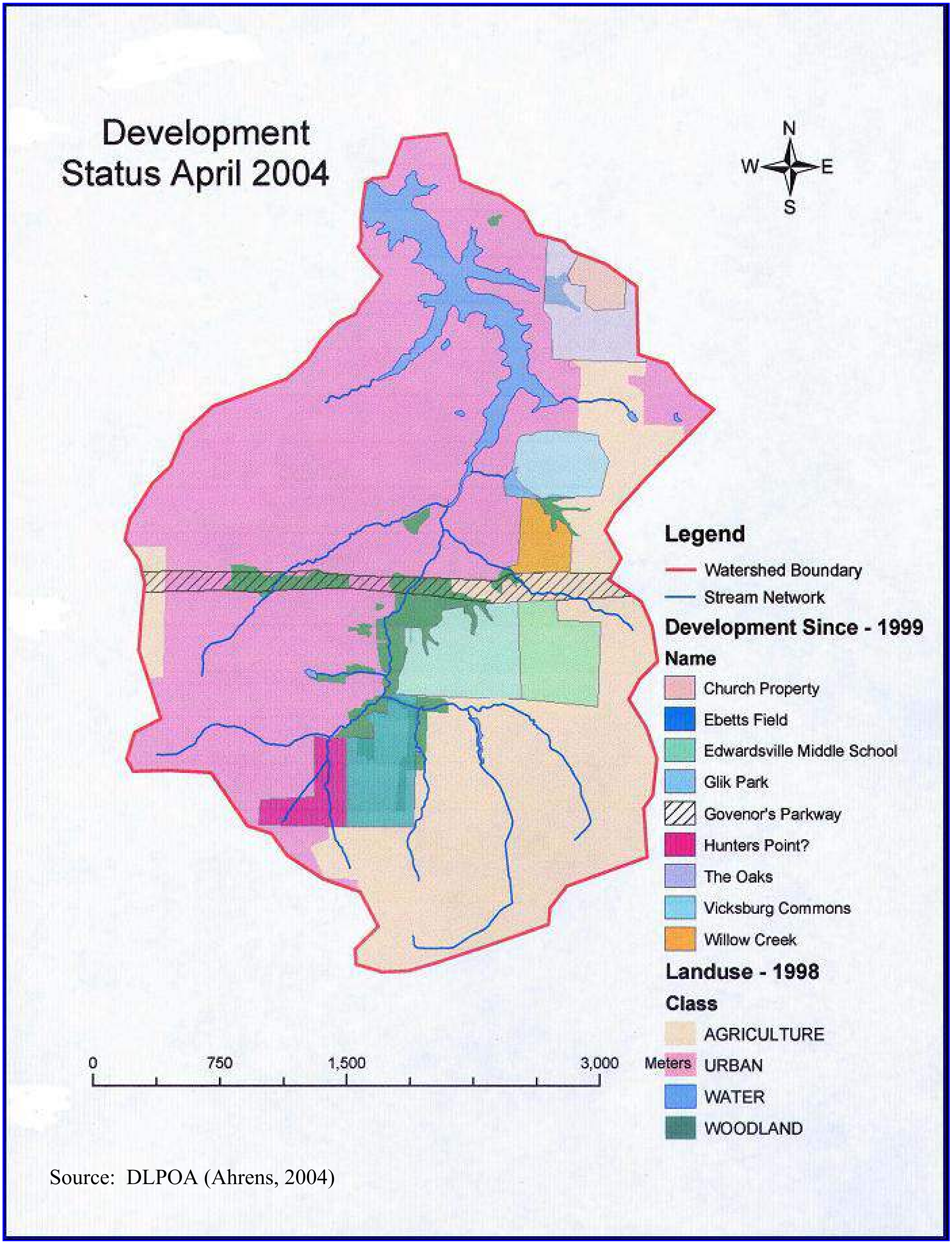


Figure 3. Watershed Land Use Map - 1998



Source: DLPOA (Ahrens, 2004)

Figure 4. Watershed Land Use and Development Status Map, April 2004

Sedimentation Survey

A sedimentation survey was completed in September 2004 to determine existing water depths and the extent of sediment deposition within Dunlap Lake. The sedimentation survey focused primarily on areas of the lake that were relatively shallow (i.e., 15 feet of water or less) and where sediment deposition was significant. Thus, the sedimentation survey included the southern two-thirds of the lake where the primary feeder streams enter, but also included other inlets along the west and east portions of the lake. This survey included locating a sufficient number of transects or cross sections, and obtaining measurements of the existing water depth and the thickness of the soft accumulated sediment along each of these cross sections (Figure 5). This information made it possible to determine the extent of sedimentation within the impacted areas of Dunlap Lake, and to quantify the sediment accumulation in terms of total cubic yards and projected restoration needs. In addition to measuring water and sediment depths at the targeted areas of the lake, selective spot measurements of existing water and sediment depths were obtained throughout the deeper areas and smaller coves of the lake.

The actual sedimentation survey was completed using a hand-held global positioning system (GPS), which was used to record data and the positions on the lake. Measurements were obtained using a one-inch diameter aluminum range pole with 0.1-foot gradation markings. Existing water depths were measured by lowering the range pole into the water at each sounding point until the top of the soft sediment was reached. The range pole was then pushed through the soft sediment until the hard, original lake bottom was reached in order to determine the thickness of the accumulated sediment. In the deeper areas of Dunlap Lake, where sediment accumulation was not considered to be an potential impairment, a digital depth-sounding device (accurate to 0.1 foot) was used to determine water depths in selected areas.

FIGURE - 5 DUNLAP LAKE SEDIMENTATION SURVEY SEGMENT LOCATIONS

Table 2. Dunlap Lake Sedimentation Survey Results

Lake Segment	Original Lake Volume or Capacity (cubic yards)	Existing Lake Volume or Capacity (cubic yards)	Volume of Sediment (cubic yards)	Percent Capacity Loss as a Result of Sediment Deposition
		Lake Sub-Area A		
1	36	22	14	38.9%
2	543	275	268	49.4%
3	589	259	330	56.0%
4	745	300	445	59.7%
5	1,213	612	601	49.5%
6	1,502	763	739	49.2%
7	1,083	450	633	58.4%
8	1,014	456	558	55.0%
9	1,175	576	599	51.0%
10	1,744	786	958	54.9%
11	1,079	474	605	56.1%
12	1,482	664	818	55.2%
13	4,847	2,178	2,669	55.1%
14	17,081	8,583	8,498	49.8%
15	41,045	21,567	19,478	47.5%
16	64,752	35,442	29,310	45.3%
17	31,874	19,166	12,708	39.9%
18	26,941	16,878	10,063	37.4%
19	103,160	69,876	33,284	32.3%
20	39,451	28,185	11,266	28.6%
21	265,074	192,468	72,606	27.4%
Subtotal Area A	**606,430**	**399,980**	**206,450**	**34.0%**
		Lake Sub-Area B		
22	2,349	1,954	395	16.8%
23	11,489	8,776	2,713	23.6%
24	28,471	19,493	8,978	31.5%
Subtotal Area B	**42,309**	**30,223**	**12,086**	**28.6%**
		Lake Sub-Area C		
25	1,530	1,255	275	18.0%
26	20,560	15,379	5,181	25.2%
27	73,753	59,926	13,827	18.7%
Subtotal Area C	**95,843**	**76,560**	**19,283**	**20.1%**
		Lake Sub-Area D		
28	4,376	2,702	1,674	38.3%
29	13,883	9,096	4,787	34.5%
30	36,005	26,614	9,391	26.1%
31	58,658	46,158	12,500	21.3%
Subtotal Area D	**112,922**	**84,570**	**28,352**	**25.1%**
Subtotal Areas A - D	**857,504**	**591,333**	**266,171**	**31.0%**
		Lake Sub-Area E		
Total Surface Area = 53.0 acres; Avg. Sediment Thickness (ft.) = 2.4'; 1.0 acre-ft = 1,613.3 cubic yards				
Subtotal E			**205,216**	**< 20.0%**
Total Sediment Volume for Whole Lake			**471,387**	

The data from the soundings was plotted at each cross section (Appendix A) so that a profile of the existing sediment and the original bottom could be developed. The average end-area-method was applied to each of the thirty-one (31) segments so that the original water storage capacity of each segment and the volume of accumulated sediment could be calculated. The locations of these lake segments are illustrated in Figure 5 and in Appendix A with enlarged views of individual sub-areas. The results for both the original storage capacity and the accumulated sediment volume are reported in cubic yards (Table 2).

The lake was divided into five (5) sub-areas (“A”, ”B”, ”C”, “D”, and “E”) (Figure 5). These sub-areas were then sub-divided into lake segments. Cross-section transects mark the boundaries of each segment, and were located by aerial photography and field reconnaissance methods. Sub-area “A” (segments 1 – 21) is located at the south end of the lake, sub-area “B“ (segments 22 – 24) is located at the east inlet near the south end of the lake, sub-area “C” (segments 25 – 27) is at the east inlet, and sub-area “D” (segments 28 - 31) is the west inlet of Dunlap Lake. Sub-area “E” was not included in the sediment survey calculation since the area near the dam was found to have minimal sediment impacts and/or water depths were generally in excess of 15 feet. The four sub-areas included in the sediment survey (sub-areas A through D) were found to have approximately 261,550 cubic yards of accumulated sediment, which accounted for a 31.5% loss of original storage capacity in the surveyed areas of Dunlap Lake. The individual segments ranged from a high of 58.6% capacity loss in the upper end of the lake where the primary tributaries or feeder streams enter sub-area “A”, to a low of 16.8% capacity loss in the upper portion of sub-area “B.”

Sub-area “A” is located at the south end of Dunlap Lake where the main tributaries to the lake enter and continues into the main body of the lake. This sub area was found to have a total of 204,523 cubic yards of accumulated sediment, which represents 34% of its original water storage capacity. Upland land use areas that drain into sub-area “A” include agriculture, existing urban/residential, woodland, and urban/residential under construction or development.

Sub-area “B” is located on the southeast side of the lake and was found to have approximately 12,086 cubic yards of accumulated sediment, which represents 28.6% of its original water storage capacity. The loss of capacity in the individual segments of sub-area “B” ranged from a high of 31.5% to a low of 16.8%, with the most significant sediment deposition occurring near the main portion of the lake (closest to sub-area “A”). Upland land use areas that drain into sub-area “B” include agriculture and residential land uses.

The amount of accumulated sediment measured in sub-area “C” was approximately 19,306 cubic yards, which represents a 20.1% loss of original water storage capacity. The capacity loss in the individual segments of sub-area “C” ranged from a high of 25.2% to a low of 18.0%. The land uses in the surrounding sub-watershed that drains into sub-area “C” include agriculture, existing urban/residential, and urban/residential under construction or development.

Sub-area “D” is a long narrow bay located near the northwest side of the lake. The sedimentation survey indicated that this sub-area has experienced an estimated loss of 27.9% of its original water storage capacity and was found to have approximately 25,635 cubic yards of sediment deposited within the measured survey transects. The sub-area “D” watershed receives runoff water from existing urban and residential areas.

The sedimentation survey included random points within the smaller inlets at the north end of Dunlap Lake and depth to bottom measurement near the dam. While these northern most inlets contained some sediment, they did not appear to have the levels of sediment deposition and subsequent capacity loss as lake sub-areas “A through D.” The random deep-water measurements indicated that the existing maximum depth is approximately 23 feet. Since sediment accumulations ranged from 1.1 to 1.8 feet in and around the area of the dam and spillway, it is estimated that the original maximum depth of the lake was approximately 25 feet.

Impacts of Storm Water Runoff (Sediment) on Receiving Waters

In general, water quality problems result primarily from five categories of non-point source pollutants that include sediment, nutrients, pesticides, toxics, and salt. Of these, sediment is probably the most common and recognized of the non-point source pollutants. As a result of soil erosion and subsequent storm water runoff, suspended sediments or solids are transported from the watershed to streams and then to receiving water bodies, there are consequences that include:

- Increased lake sedimentation (reduced lake volumes);
- Reduced aesthetic values (reduced water clarity);
- Reduced light penetration through the water column, which adversely impacts aquatic vegetation growth;
- Reduced predation opportunities for sight feeding fish (reduced angling success); and
- Potential for increased toxicants and trace metals that are attached to sediment.

Local Erosion Control Ordinances

CWI obtained a copy of the City of Edwardsville's erosion control ordinance for site development entitled *An Ordinance Providing for the Control of Soil Erosion and Sedimentation from Areas Undergoing Development*. After reviewing the local ordinance, CWI contacted and then met with several city officials including the Director of Public Works, the City Engineer, and the supervisor for the city's site inspection program to discuss the local ordinance, the enforcement of the ordinance, and the general history of Dunlap Lake. The city stated that the BMP's outlined in the ordinance are those described in the *Illinois Urban Manual*, which is a technical manual for urban ecosystem protection and enhancement. The publication was prepared and published by the Illinois Association of Soil and Water Conservation Districts and is recognized by the Madison County Soil and Water Conservation District.

The existing ordinance contains specific guidelines and requirements for site development permits, operational standards and requirements, and enforcement measures. Conversations with the local Natural Resource Conservation Service

(NRCS) and Illinois EPA field inspectors indicated that Edwardsville's soil control ordinance for construction projects is progressive and goes beyond most of the requirements of other local municipalities. Based on review of the existing ordinance and conversations and meetings with city and local officials, it appears that the City of Edwardsville has a comprehensive site development soil erosion and sedimentation control ordinance and has made reasonable attempts to inspect construction projects and areas under development.

Summary of Findings, Recommendations, and Estimated Costs

The greatest percentage of sediment deposition has occurred at the south end of the lake where the primary tributaries or feeder streams enter from the relatively large drainage area (2,000 acres) of sub-watersheds A-1, A-2, A-3, A-4, A-5, and B-1. Within the impacted section of sub-area "A" (segments 1 – 18), approximately 89,296 cubic yards or approximately 44.9 percent of the original water storage capacity has been lost to accumulated sediment (See Table 3). The degree of impact from sediment deposition in sub-area "A" is relatively continuous throughout lake segments 1 through 18, which begins near the intersection of Gerber Road and East Lake Road and extends past the mouth of sub-area "B". The vast extent of accumulated sediment in sub-area "A" of the lake is not unexpected considering the narrow riverine channel morphology, which allows high flow velocities to carry fine-grained suspended sediment far into the main body of the lake. If the gradual historical loss of lake storage volume and water depth is not corrected, by implementing sediment management measures such as sediment load reduction and sediment removal, additional water storage capacity will likely be lost as sediment deposition continues to prograde further north into the main body of the lake.

The impacted area of sub-area "B" or the east bay located near the south end of the lake extends the entire 850 feet of the inlet. This small bay at the southeast end of the lake connects to the main body of the lake (sub-area "A") at a point where sediment deposition from sub-area "A" is still significant.

Table 3. Dunlap Lake Segments Negatively Impacted by Sedimentation

Lake Segment	Original Capacity (cubic yards)	Existing Capacity (cubic yards)	Volume of Sediment (cubic yards)	Percent Capacity Loss
		Lake Sub-Area A		
1	36	22	14	38.3%
2	543	275	268	49.3%
3	590	260	330	55.9%
4	747	301	446	59.7%
5	1,215	614	601	49.5%
6	1,506	765	741	49.2%
7	1,087	450	637	58.6%
8	1,019	458	560	55.0%
9	1,175	579	596	50.7%
10	1,740	786	953	54.8%
11	1,071	471	600	56.0%
12	1,477	659	818	55.4%
13	4,847	2,169	2,678	55.2%
14	17,121	8,603	8,518	49.8%
15	41,060	21,560	19,500	47.5%
16	74,236	39,872	34,364	46.3%
17	36,725	21,443	15,282	41.6%
18	22,516	14,581	7,934	35.2%
Subtotal	**208,708**	**113,869**	**94,839**	**45.4%**
		Lake Sub-Area B		
22	2,349	1,954	395	16.8%
23	11,489	8,776	2,713	23.6%
24	28,471	19,493	8,978	31.5%
Subtotal	**42,309**	**30,223**	**12,086**	**28.6%**
		Lake Sub-Area C		
25	1,530	1,255	275	18.0%
26	20,570	15,379	5,191	25.2%
Subtotal	**22,099**	**16,634**	**5,466**	**24.7%**
		Lake Sub-Area D		
28	4,376	2,702	1,674	38.2%
29	13,883	9,096	4,787	34.5%
30	36,005	26,614	9,391	26.1%
Subtotal	**54,263**	**38,412**	**15,851**	**29.2%**
Total	**327,380**	**199,138**	**128,242**	**39.2%**

Therefore, it is not surprising that the sediment distribution in sub-area “B” is more extensive near main body of the lake or sub-area “A.” This suggests that a significant percentage of the sediment deposition in sub-area “B” was likely to have originated from sediment delivered from sub-watersheds A-1, A-2, A-3, and A-4 rather than from sub-watershed B-1. The sub-watershed B-1 that drains into sub-area “B” is approximately 159 acres or 6.1 percent of the entire watershed. The lake segments within sub-area “B” (22 through 24) were found to have approximately 12,086 cubic yards of sediment, which accounts for a 28.6 percent loss in original water storage capacity.

The C-1 sub-watershed is approximately 92 acres (3.5 percent of the total watershed) and drains into sub-area “C”, which is the east inlet near the north end of the lake. According to the survey cross sections, it was determined that the impacted area in sub-area “C” was limited to lake segments 25 through 26, where approximately 24.7 percent of the original water storage capacity has been lost and 5,456 cubic yards of sediment have been deposited. Since the maximum water depth at Section 06+61C (downstream end of impacted area) was found to range from 7.0 to 9.0 feet with sediment depths of 3.0 to 4.0 feet, it has been estimated that the impacted area extends approximately 200 feet into segment 27. The estimated sediment volume in the partial lake segment 15 is approximately 3,193 cubic yards. Therefore, the total estimated sediment volume in the impacted area of sub-area “C” is 8,648 cubic yards.

Sub-watershed D-1 drains 327 acres (12.5 percent of the total watershed) into the west inlet or sub-area “D” of the lake. The sediment survey cross sections indicate that the impacted area has been confined to lake segments 28 through 30, which have lost 29.2 percent of their original water storage capacity and approximately 15,851 cubic yards of sediment has been deposited.

Table 2 indicates that a total of 266,171 cubic yards of sediment have been deposited in the cross-sectioned areas of the lake and the remaining deep area at the north end of the lake (sub-area “E”) was estimated to have 205,216 cubic yards of sediment. The limits of the negatively impacted areas were determined by a combination of existing and original bottom depth, sediment thickness and the percent water storage capacity lost to sediment. This rationale of determining impacted areas is based on past professional experience and other supporting documentation that considers water quality, habitat, navigation, and economics of sediment removal. Based on this rationale, Table 6 summarizes the volume of in-lake sediment that falls within the surveyed areas and extends out to a point that we consider to be impacted. The total volume of sediment measured in the impacted segments of sub-areas “A”, “B”, “C”, and “D” is approximately 125,881 cubic yards. If the sediment were removed from the impacted areas of the lake, recreational access in the lake would be restored and expanded, and water quality would improve.

The sediment should be removed from the lake by hydraulic dredging and placed in an upland containment and dewatering site, preferably on flat or gently sloping land that is owned by DLPOA or on an agricultural field or park that drains back into the lake. This agricultural land could benefit from the reclaimed topsoil if the dried sediment is graded properly after the dredging project has been completed. Mechanical dredging of the lake by dragline or excavator is not recommended due to unacceptable shoreline access for equipment.

Table 3 summarizes the various work tasks that would be required for a sediment removal project and the estimated costs for completion. Land acquisition costs for sediment storage and dewatering have not been included in this summary since it is not clear what arrangements may be secured until a project is initiated. It is likely that a short-term lease arrangement that includes site reclamation will be the most cost effective approach. For a project of this size, one to two years after dredging is complete is a normal time period to allow for sufficient drying time for site grading and reclamation. If multiple site are required due to limited land availability, the costs of designing and constructing multiple facilities would be greater than for one, single retention pond.

Table 4. Estimate of Probable Sediment Removal Costs

Sediment Removal Work Task	Total Dredging Quantity	Estimated Cost
Dredging – All Impacted Areas ($2.50 to $3.00/CY)	125,881 cy	$ 314,702 - $ 377,643
Dredge Mobilization and Demobilization		$ 60,000 - $ 80,000
Construct Retention/Dewatering Pond (12-15 acres)		$ 100,000 - $ 120,000
Subtotal		$ 474,702 - $ 577,643
Contingency (10%)		$ 47,470 - $ 57,764
Subtotal incl. Contingency		$ 522,172 - $ 635,407
Engineering and Permitting (15%)		$ 78,326 - $ 95,311
Total Estimated Cost for Dredging		**$ 600,498 - $ 730,718**
Probable Site Reclamation Cost	**1 L.S.**	**$ 50,000 - $ 75,000**

The preliminary estimate of probable cost for dredging all sediment within the impacted areas ranges from $600,498 to $730,718. The probable cost range for site grading and reclamation is $50,000 to $75,000 and would likely be completed one to two years after dredging under a separate engineering/construction contract. More accurate costs can be determined prior to actual project implementation by requesting bids from several appropriate contractors. Our scope of engineering services of engineering services for a future dredging and lake restoration project would include design, permitting, bid document preparation, and coordination of potential bidders.

A list of qualified hydraulic dredging contractors has been provided as shown below for informational purposes. Additional contractors may also be available within the locale of greater St. Louis and surrounding states, and could easily be included on a prospective bidders list when a sediment removal project has been designed, permitted, and is scheduled for bidding and implementation at Dunlap Lake.

Mid America Dredging
P.O. Box 168 RR 3
Macomb, Illinois 61455

Energy Resources, Inc.
2206 Samuel Stuart Court
Chesterfield, MO 63005

Inland Dredge Company, Inc.
3011 Knollcrest Drive
Burlington, Wisconsin 53105

Southwind Construction Co.
14649 Highway 41 North
Evansville, IN 47711

Tennant's Industrial Dredging, Inc.
3130 North 21st Street
Terre Haute, Indiana 47804

Dredge America
9555 NW Highway N
Kansas City, MO 64153

Over the sixty-five plus year history of the lake, it is probable that a significant percentage of the accumulated sediment pre-dates many of the recent land use changes (i.e., development) in the watershed. The results of the sedimentation survey (i.e., 31.5 percent of lake capacity lost within sub-areas "A through D") and continuous extent of accumulated sediment throughout these sub-areas suggests that the existing sediment conditions are most likely due to long-term agricultural and urban runoff impacts over the lifespan of the lake and its watershed.

Development and construction within the Dunlap Lake watershed are noted and these processes will continue. While under development, these transitional areas can increase sediment loading and delivery rates to the watershed and lake. However, these increases are often from small-disturbed areas that are short-term in nature. They are typically being completed and replaced with residential and/or urban land use types that have considerably less sediment delivery rates than from agricultural land uses.

In addition to the recommended sediment removal requirements described above, sediment management measures should also include efforts to minimize the volume of suspended sediment entering the lake so that the benefits of any sediment removal efforts are longer lasting (see Figure 6). As discussed earlier in the report, the DLPOA requested support from the local NRCS District Engineer to design a suitably sized sediment basin to effectively trap and control excessive sediment loads entering the lake from the south end.

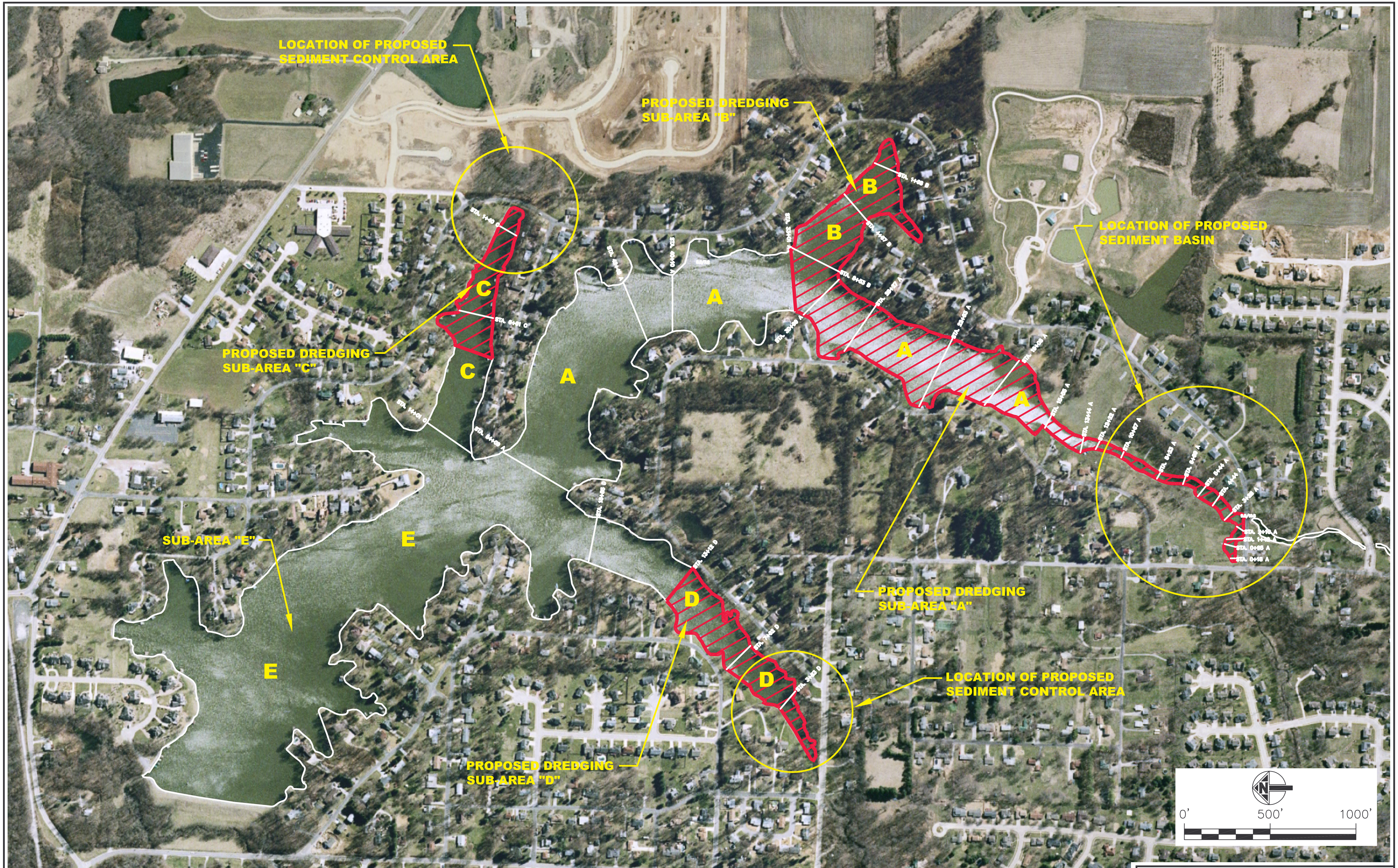


FIGURE 6 - PROPOSED SEDIMENT MANAGEMENT OPTIONS

Prior to design, it was reported that the NRCS suggested that an optimum sediment basin would provide at least an eighty to ninety percent sediment trapping or removal efficiency. However, since the land area available (owned by the DLPOA) for the proposed sediment control basin at the south end of Dunlap Lake was limited, navigational access to the main body of the lake was desired, and temporary upstream flooding was not feasible, the final design was estimated to provide approximately 30 to 40 percent sediment trapping efficiency at a total estimated cost of $134,800.

After carefully reviewing the NRCS design, we feel that several enhancements could easily be incorporated to improve the sediment trapping effectiveness by as much as 20 percent and to increase the functional lifespan of the basin before maintenance dredging is required (see Figure 7). These enhancements include deepening the basin an additional four feet to a bottom elevation of 502.0; creating a flow diversion system to provide improved utilization of the basin for sediment to settle out. Strategically installing floating silt curtains or raising the elevation of the interior submerged flow control/maintenance access dikes could initiate effective flow diversion while providing a method to prevent debris from entering the main body of the lake. Excavating an additional four feet of material for a 502.0 elevation bottom for improved sediment trapping, an additional 25,000 cubic yards would have to be excavated and hauled away at an estimated cost of $100,000 to $125,000 ($4.00 to $5.00 per cubic yard). In addition to the increased water depth for improved effectiveness and longevity, floating silt/debris curtains can be installed along a portion of the submerged low head dikes within the basin. A total of 350 linear feet of two ft. skirt length floating curtain could be installed for approximately $12,000 to $15,000. An alternative approach could include raising the elevation of the submerged interior dikes to function in a similar manner. However, if the interior dikes are higher than the normal water surface elevation of 510.2 then riprap protection will be required. Engineering, permitting and construction phase assistance would be an additional cost to be determined once options are selected (approx. 15% of construction costs).

FIGURE 7. NRCS SEDIMENT BASIN WITH ENHANCEMENTS – AREA A

The recent development of the Oaks subdivision within the sub-watershed C-1 has been an issue of concern for the DLPOA. Prior to development of the subdivision, the local developer was required to submit engineering plans to control storm water runoff and obtain a construction permit under the City of Edwardsville's (City) Erosion Control Ordinance (ordinance). In order to reduce the impacts from storm water runoff, the developer prepared engineering plans for a 0.50-acre detention basin and a multi-tiered concrete detention basin outlet structure between Redwood Drive and East Lake Drive. These structural BMPs were intended to collect and control storm water runoff and detain it until the storm water or runoff could be discharged at a reduced rate to minimize the impacts to Dunlap Lake. The location of the detention basin was located between a 1.19-acre wetland, which triggered another set of permitting requirements. The developer subsequently submitted engineering plans and a Section 404 permit application to the St. Louis District of the U.S. Army Corps of Engineers (COE) to construct the detention basin and outlet structure near or within the regulated wetland. The COE approved the permit application and issued permit #200104780. As part of the permit requirement, it was stated that storm water flow to the wetland could not be prevented or reduced.

During normal flow conditions and after light to moderate precipitation events (i.e. one quarter on an inch or more of rain), turbid storm water runoff has been observed "short-circuiting" or flowing through the detention basin and the wetland, and into the lower culvert pipe opening of the outlet structure, which discharges directly into sub-area "C" of Dunlap Lake. The DLPOA recognizes that the existing detention basin and outlet structure were a good faith effort to control storm water runoff and that no storm water BMP is completely effective in reducing all impacts from runoff. However, enhancements could be made to the existing detention basin and outlet structure that would improve storm water detention and sediment trapping efficiency (see Figure 8). These enhancement efforts would likely be funded and completed by the DLPOA, and would require City and COE permit modifications. However, an improved and cooperative relationship between the DLPOA and the local developer, and the City would be required.

FIGURE 8. SEDIMENT REDUCTION OPTIONS – AREA C

At the time of this report, coconut fiber rolls were positioned across the lower end of the detention basin in order to provide some detention. However, these natural fiber rolls have been observed to provide low head (i.e., limited detention) and are subject to eventual biodegradation. This “detention“ structure could easily be enhanced by installing a more permanent barrier that would be resistant to degradation and allow storm water to be detained more effectively while allowing water to flow at a reduced rate through the basin. We estimate that a more effective, earthen berm for improved storm water detention with a riprap outlet/weir for additional storm water filtering could be designed, permitted and installed (with landowner/developer approval) for approximately $5,000 to $8,000. The enhanced system could also include a two to three foot vertical slotted riser to slowly release storm water into the lower wetland area in order to satisfy permit requirements.

The bottom invert for the lower-most intake on the detention basin outlet structure is at or near the bottom elevation of the wetland, which causes the run-off to “short-circuit” through the wetland without any additional temporary detention. A slotted, vertical riser could be retrofitted to the lower-most intake on the detention basin outlet structure that would allow runoff to discharge to Dunlap Lake at a reduced rate. This minor modification would temporary detain storm water to allow sediment to settle out via gravity and reduce the sediment loads to Dunlap Lake. The small slotted openings in the riser (2 to 3 feet in height) would slowly release the storm water.

Another potential outlet structure modification is a small riprap berm or slotted corrugated metal barrier (two to three feet high) around the bottom invert for the lower-most intake on the detention basin outlet structure. This modification would allow flow to pass through at a reduced rate, while filtering sediment and providing additional detention time.

These low technology and relatively low cost modifications to the detention basin, wetland, and outlet structure may slightly alter the hydraulics of the system, and if implemented, this issue would need to be addressed and considered within a permit modification submitted to the COE. We estimate that modifications as described above could be designed, permitted and installed for $5,000 to $8,000 pending landowner and City approval.

Attempts were made to contact several officials from the City of Edwardsville (City) and St. Louis District of the U.S. Army Corps of Engineers (COE) to discuss the status and the possibility of enhancing the detention basin. Based on limited conversations with the COE, it the understanding of CWI, that the plan for the engineering design of the detention basin and outlet structure were submitted to, and approved by, the City and the COE.

The most feasible BMPs to implement are those located on DLPOA owned land. A floating curtain or barrier could be installed within sub-area "C" of Dunlap Lake near the culvert that discharges runoff from the Oaks detention basin outlet structure. This "turbidity curtain" would help diminish flow velocities and would enhance sediment deposition to be confined in a localized area near the culvert. Attached at the shoreline, the curtain would extend across the water's surface and would extend downward and anchored to a depth of approximately one to two feet off the bottom.

Typical Floating Silt Control Curtains (Gunderboom, Inc.)

The same type of floating silt control curtain could also be placed at the upstream end of sub-area “D” (see Figure 9). A silt control curtain was not found to be necessary at the upstream end of sub-area “B” due to the minimal volume of sediment measured at cross section 1+68B. Each of these 100 ft. long floating curtains could be acquired and installed for approximately $5,000 to $8,000 including engineering selection and assistance. Maximum sediment trapping effectiveness of the floating curtain would be obtained after all sediment has been removed from the semi-confined area. Gunderboom Corporation has an excellent product known as the Particulate Control System (PCS) and is recommended.

Finally, we feel that developing a more cooperative relationship between the DLPOA and the City of Edwardsville, local developers, and other local officials will be critical for the success of all future DLPOA efforts. In order to successfully implement the sediment management measures outlined in this report, it is also imperative that the DLPOA gain land owner cooperation through tactful, friendly and cooperative discussion.

FIGURE 9. SEDIMENT REDUCTION OPTIONS – AREA D

Appendices

	PROJECT	Dunlap Lake		SUBJECT:	Sediment Volumes by Lake Sub-Area and Segment					
		END AREA		SUM AREAS			SECT. TOTALS			
SEGMENT	STATION	Original	Existing	Original	Existing	DIST.	Original	Existing	Sediment	% Loss
	0+00A									
1				54	33	18	36	22	14	38.3%
	0+18A	107	66							
2				191	97	77	543	275	268	49.3%
	0+95A	274	127							
3				339	149	47	589	259	330	56.0%
	1+42A	403	171							
4				296	119	68	745	300	446	59.8%
	2+10A	189	67							
5				278	140	118	1,213	612	601	49.5%
	3+28A	366	213							
6				350	178	116	1,502	763	739	49.2%
	4+44A	333	142							
7				293	122	100	1,083	450	633	58.5%
	5+44A	252	101							
8				219	99	125	1,014	456	558	55.0%
	6+69A	186	96							
9				206	101	154	1,175	576	599	51.0%
	8+23A	226	106							
10				193	87	244	1,744	786	958	54.9%
	10+67A	160	68							
11				188	83	155	1,079	474	606	56.1%
	12+22A	216	97							
12				435	195	92	1,482	664	818	55.2%
	13+14A	654	293							
13				543	244	241	4,847	2,178	2,669	55.1%
	15+55A	432	195							
14				1,307	657	353	17,081	8,583	8,498	49.8%
	19+08A	2,181	1,118							
15				2,879	1,513	385	41,045	21,567	19,478	47.5%
	22+93A	3,576	1,907							
16				3,274	1,792	534	64,752	35,442	29,311	45.3%
	28+27A	2,972	1,677							
17				3,164	1,903	272	31,874	19,166	12,708	39.9%
	30+99A	3,356	2,128							
18				3,601	2,256	202	26,941	16,878	10,063	37.4%
	33+01A	3,846	2,384							
19				3,929	2,661	709	103,160	69,876	33,284	32.3%
	40+10A	4,011	2,938							
20				4,476	3,198	238	39,451	28,185	11,265	28.6%
	42+48A	4,940	3,457							
21				6,165	4,476	1,161	265,074	192,468	72,606	27.4%
	54+09A	7,389	5,495							
				3,695	2,748					
Sub-Area A							**606,430**	**399,980**	**206,450**	**34.0%**
	00+00B									
22				378	314	168	2,349	1,954	395	16.8%
	1+68B	755	628							
23				1,038	793	299	11,489	8,776	2,713	23.6%
	4+67B	1,320	957							
24				1,992	1,364	386	28,471	19,493	8,978	31.5%
	8+53B	2,663	1,770							
				1,332	885					
Sub-Area B							**42,309**	**30,223**	**12,086**	**28.6%**
	00+00C									
25				295	242	140	1,530	1,255	275	18.0%
	1+40C	590	484							
26				1,066	797	521	20,560	15,379	5,181	25.2%
	6+61C	1,541	1,110							
27				2,691	2,187	740	73,753	59,926	13,827	18.7%
	14+01C	3,841	3,263							
				1,921	1,632					
Sub-Area C							**95,843**	**76,560**	**19,283**	**20.1%**
	00+00D									
28				309	191	383	4,376	2,702	1,674	38.2%
	3+83D	617	381							
29				989	648	379	13,883	9,096	4,787	34.5%
	7+62D	1,361	915							
30				1,768	1,307	550	36,005	26,614	9,391	26.1%
	13+12D	2,174	1,698							
31				2,764	2,175	573	58,658	46,158	12,500	21.3%
	18+85D	3,354	2,652							
				1,677	1,326					
Sub-Area D							**112,922**	**84,571**	**28,351**	**25.1%**
		Total Cubic Yards of Sediment in Segments 1-31 (Sub-areas A, B, C and D					**857,505**	**591,334**	**266,170**	**31.0%**
Sub-Area E	53 Acres	Avg. Sediment (ft.)	2.4'	1 acre-ft. = 1,613.33 cubic yards					**205,216**	
	Total Cubic Yards of Sediment Estimated to be in Dunlap Lake								**471,386**	

⊠ 20.2	EXISTING WATER DEPTH
⊠ 11.4/12.9	EXISTING WATER DEPTH/ORIGINAL BOTTOM DEPTH

NOTE: THE DIFFERENCE BETWEEN THE ORIGINAL BOTTOM DEPTH AND THE EXISTING WATER DEPTH EQUALS THE SEDIMENT THICKNESS

SEDIMENT SURVEY PLAN
SUB AREA "A"

DUNLAP LAKE WATERSHED STUDY
AND LAKE MANAGEMENT PLAN

Designed: P.B.
Checked:
Drawn: M.G.
Checked:

Cochran & Wilken, Inc.
Consulting Engineers & Scientists
5201 South Sixth Street Road, Springfield, IL 62703-5143
Ph. (217) 585-8300

Date: 1/24/05
Sheet No. C-2
of

Job No: 04068
File No:

⊠ 20.2 EXISTING WATER DEPTH

⊠ 11.4/12.9 EXISTING WATER DEPTH/ORIGINAL BOTTOM DEPTH

NOTE: THE DIFFERENCE BETWEEN THE ORIGINAL BOTTOM DEPTH AND THE EXISTING WATER DEPTH EQUALS THE SEDIMENT THICKNESS

SEDIMENT SURVEY PLAN
SUB AREA "A" AND "B"

DUNLAP LAKE WATERSHED STUDY AND LAKE MANAGEMENT PLAN

Designed: P.B. Checked: Drawn: M.G. Checked:	Cochran & Wilken, Inc. Consulting Engineers & Scientists 5201 South Sixth Street Road, Springfield, IL 62703-5143 Ph. (217) 585-8300	Date: 1/24/05 Sheet No. C-3 of	
Job No: 04068		File No:	

20.2 EXISTING WATER DEPTH

11.4/12.9 EXISTING WATER DEPTH/ORIGINAL BOTTOM DEPTH

NOTE: THE DIFFERENCE BETWEEN THE ORIGINAL BOTTOM DEPTH AND THE EXISTING WATER DEPTH EQUALS THE SEDIMENT THICKNESS

SEDIMENT SURVEY PLAN SUB AREA "A" AND "C"		
DUNLAP LAKE WATERSHED STUDY AND LAKE MANAGEMENT PLAN		
Designed: P.B. Checked: Drawn: M.G. Checked:	Cochran & Wilken, Inc. Consulting Engineers & Scientists 5201 South Sixth Street Road, Springfield, IL 62703-5143 Ph. (217) 585-8300	Date: 1/24/05 Sheet No. C-4 of
Job No: 04068		File No:

SEDIMENT SURVEY PLAN
SUB AREA "D"

DUNLAP LAKE WATERSHED STUDY
AND LAKE MANAGEMENT PLAN

Designed: P.B.
Checked:
Drawn: M.G.
Checked:

Cochran & Wilken, Inc.
Consulting Engineers & Scientists
5201 South Sixth Street Road, Springfield, IL 62703-5143
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Date: 1/24/05
Sheet No. C-5
of

Job No: 04068
File No:

⊠ 20.2	EXISTING WATER DEPTH
⊠ 11.4/12.9	EXISTING WATER DEPTH/ORIGINAL BOTTOM DEPTH

NOTE: THE DIFFERENCE BETWEEN THE ORIGINAL BOTTOM DEPTH AND THE EXISTING WATER DEPTH EQUALS THE SEDIMENT THICKNESS

SEDIMENT SURVEY PLAN
SUB AREA "E"

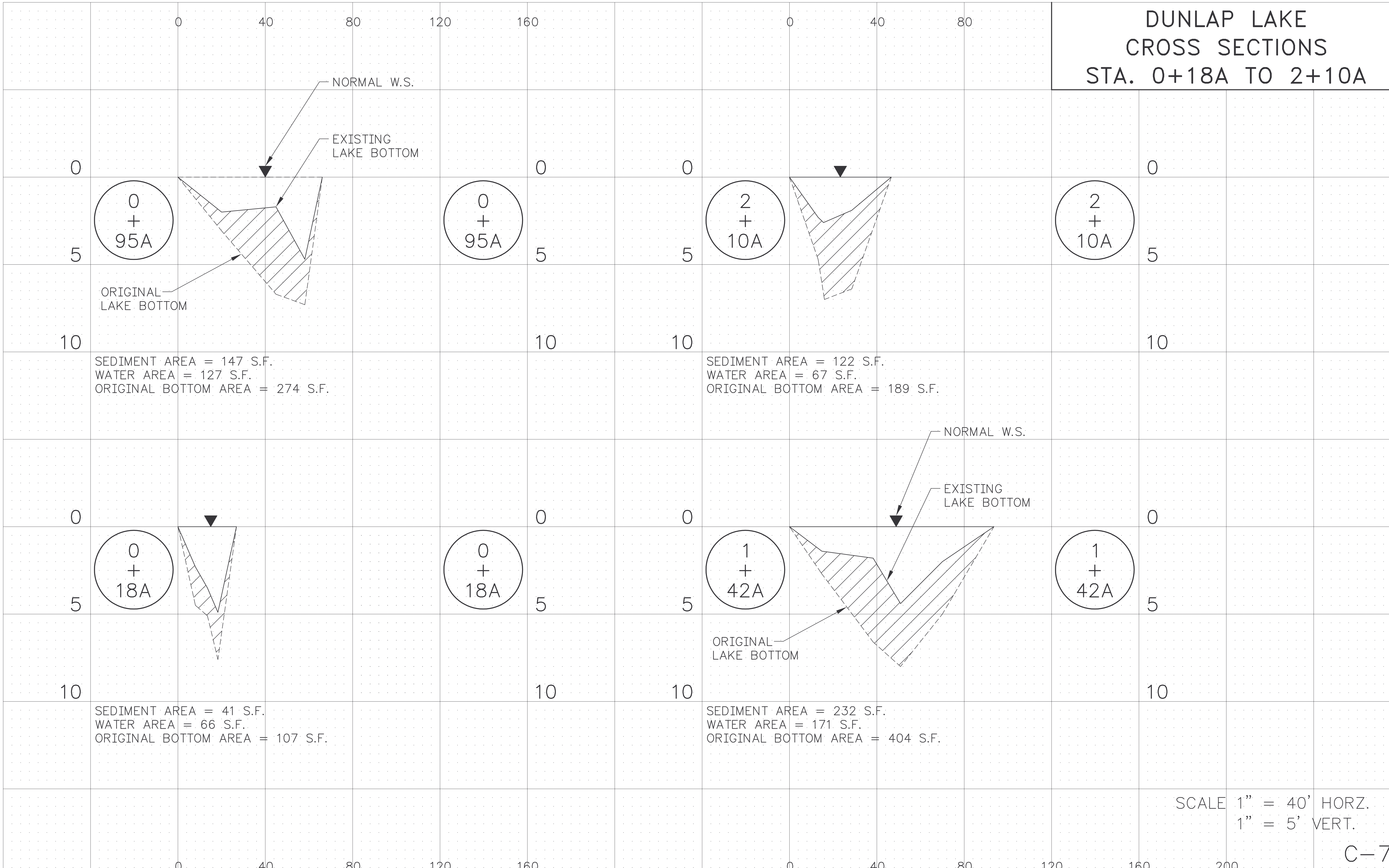
DUNLAP LAKE WATERSHED STUDY
AND LAKE MANAGEMENT PLAN

Designed:
Checked:
Drawn:
Checked:

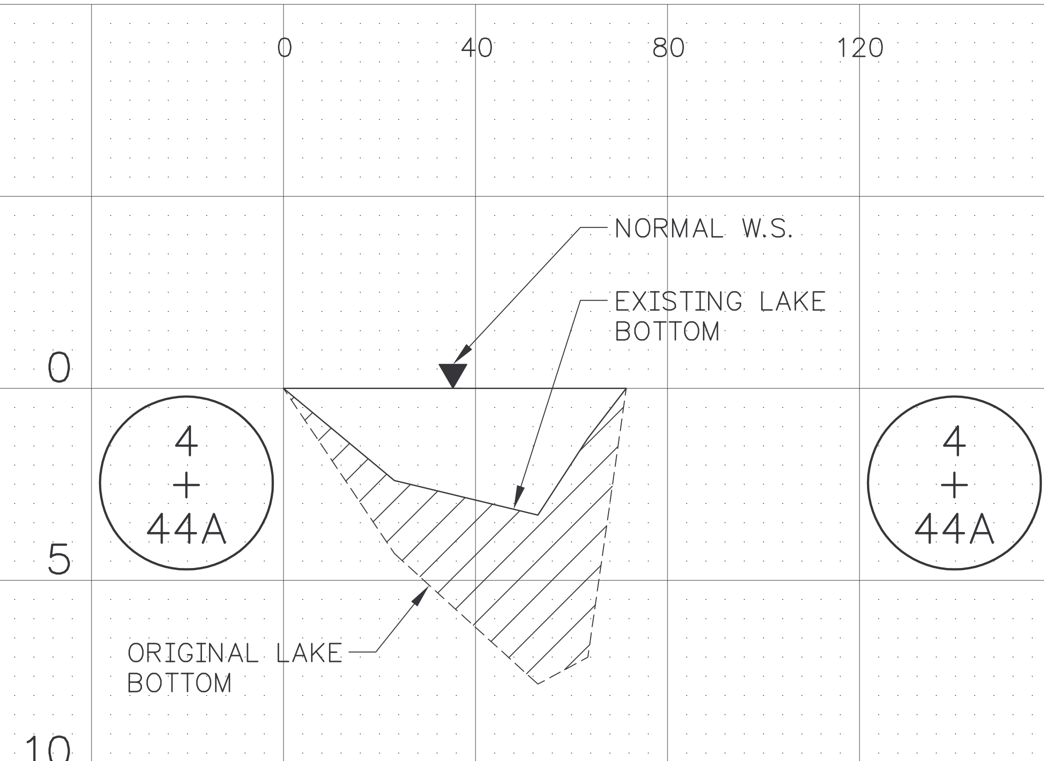
Cochran & Wilken, Inc.
Consulting Engineers & Scientists
5201 South Sixth Street Road, Springfield, IL 62703-5143
Ph. (217) 585-8300

Date: 1/24/05
Sheet No. C-6
of

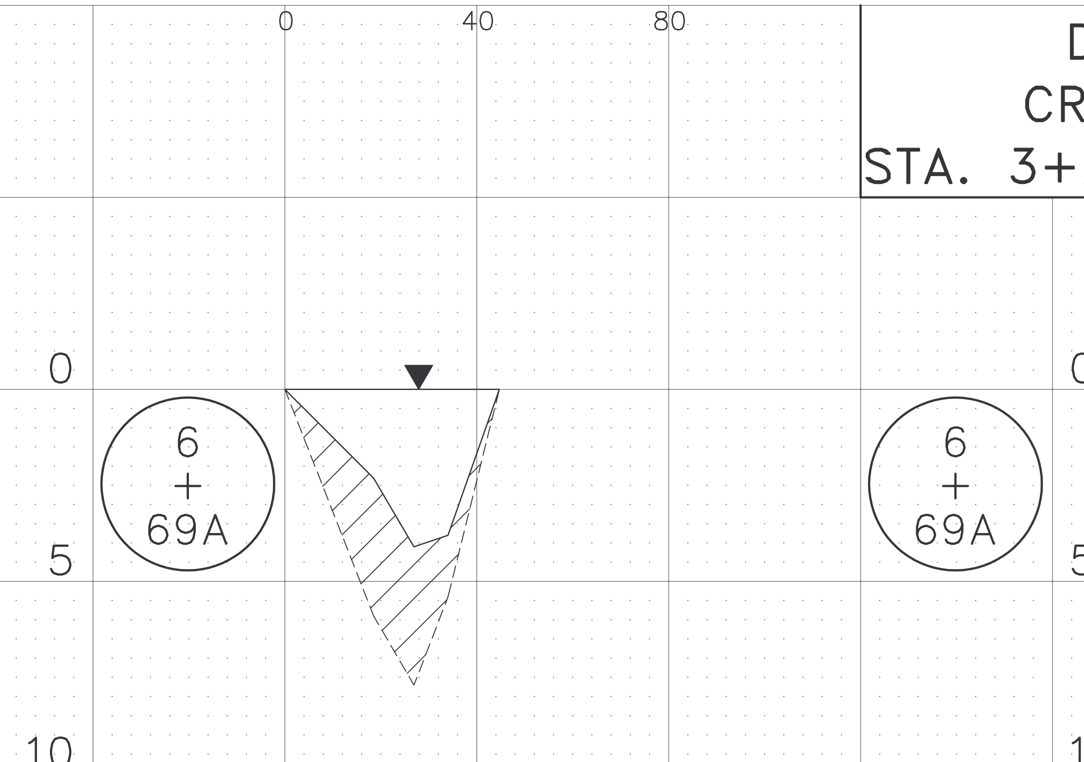
Job No: 04068
File No:


DUNLAP LAKE
CROSS SECTIONS
STA. 0+18A TO 2+10A
0+95A
NORMAL W.S.
EXISTING LAKE BOTTOM
ORIGINAL LAKE BOTTOM
SEDIMENT AREA = 147 S.F.
WATER AREA = 127 S.F.
ORIGINAL BOTTOM AREA = 274 S.F.
2+10A
SEDIMENT AREA = 122 S.F.
WATER AREA = 67 S.F.
ORIGINAL BOTTOM AREA = 189 S.F.
0+18A
SEDIMENT AREA = 41 S.F.
WATER AREA = 66 S.F.
ORIGINAL BOTTOM AREA = 107 S.F.
1+42A
NORMAL W.S.
EXISTING LAKE BOTTOM
ORIGINAL LAKE BOTTOM
SEDIMENT AREA = 232 S.F.
WATER AREA = 171 S.F.
ORIGINAL BOTTOM AREA = 404 S.F.
SCALE 1" = 40' HORZ.
1" = 5' VERT.
C–7

DUNLAP LAKE
CROSS SECTIONS
STA. 3+28A TO STA. 6+69A



SEDIMENT AREA = 191 S.F.
WATER AREA = 142 S.F.
ORIGINAL BOTTOM AREA = 333 S.F.



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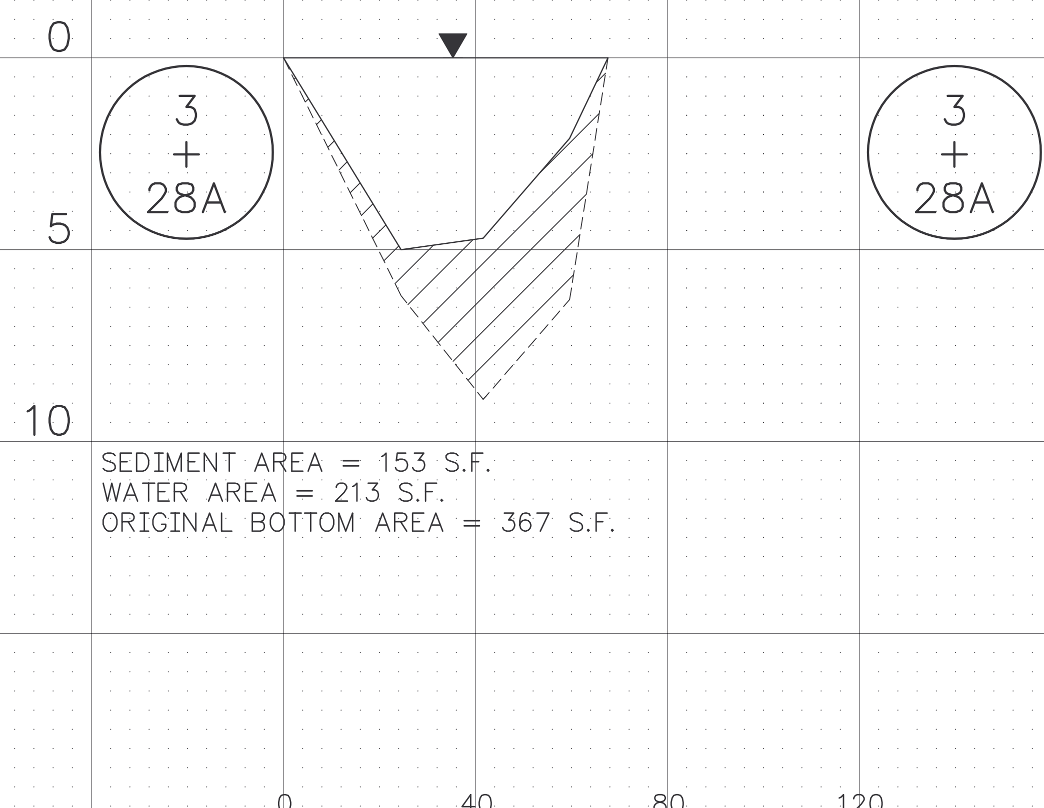
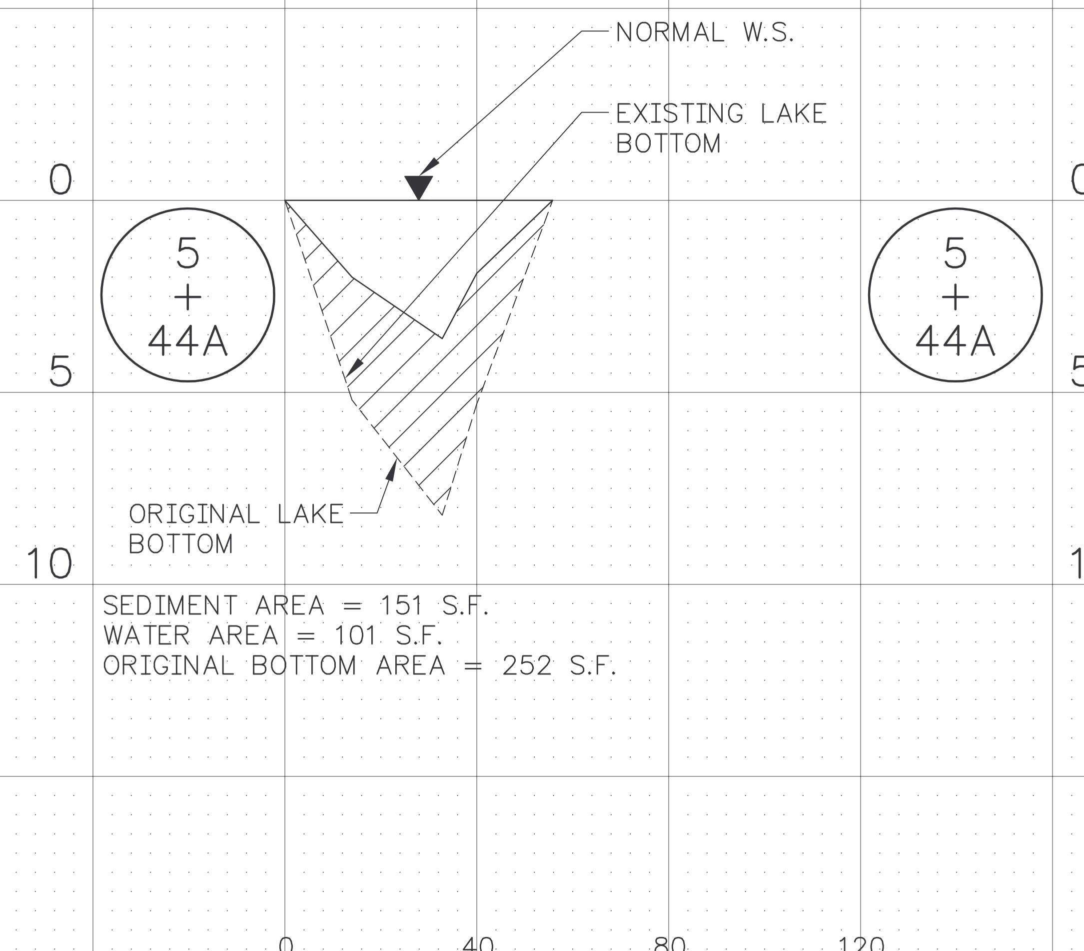
WATER AREA = 96 S.F.
ORIGINAL BOTTOM AREA = 187 S.F.

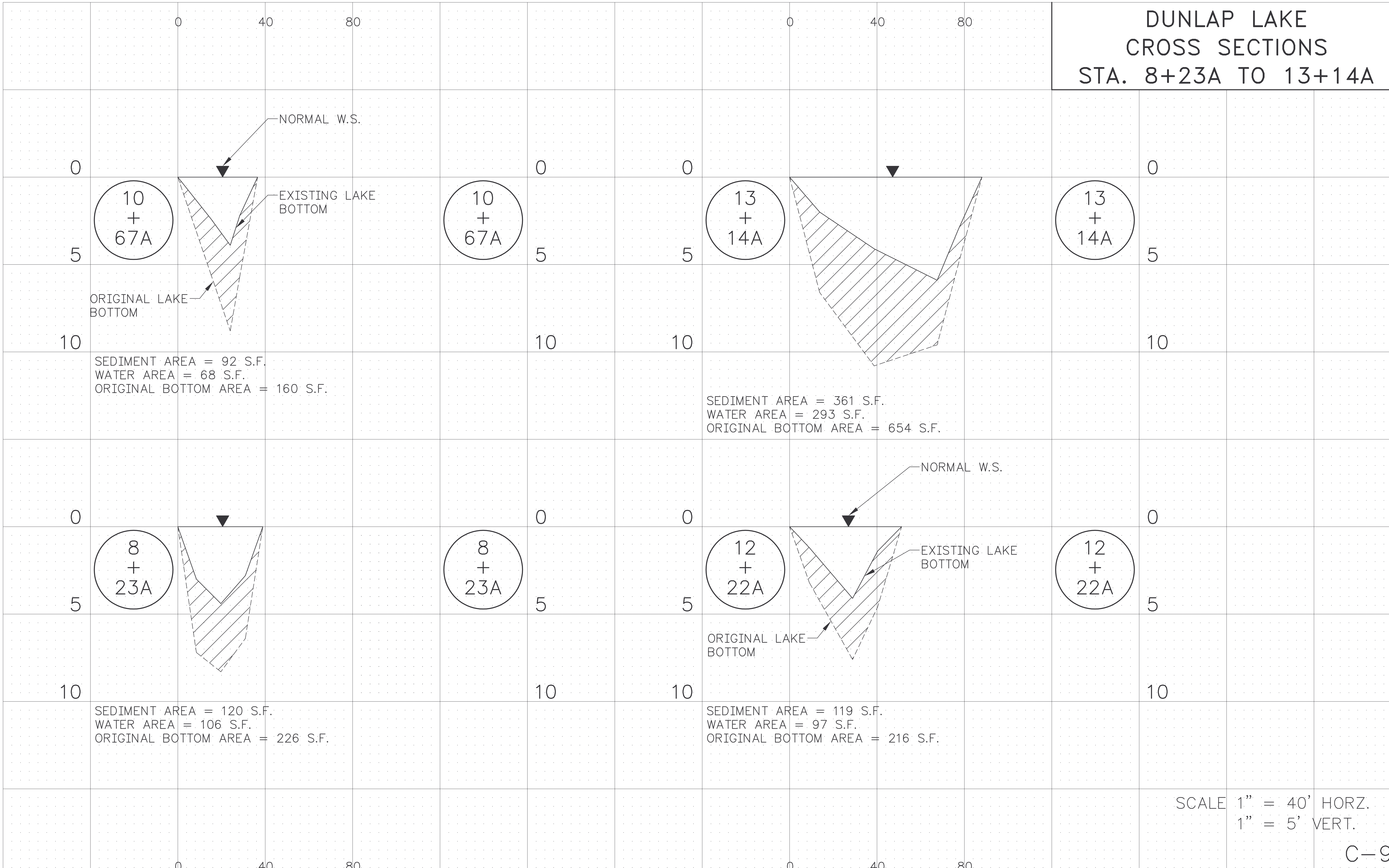


SEDIMENT AREA = 153 S.F.
WATER AREA = 213 S.F.
ORIGINAL BOTTOM AREA = 367 S.F.

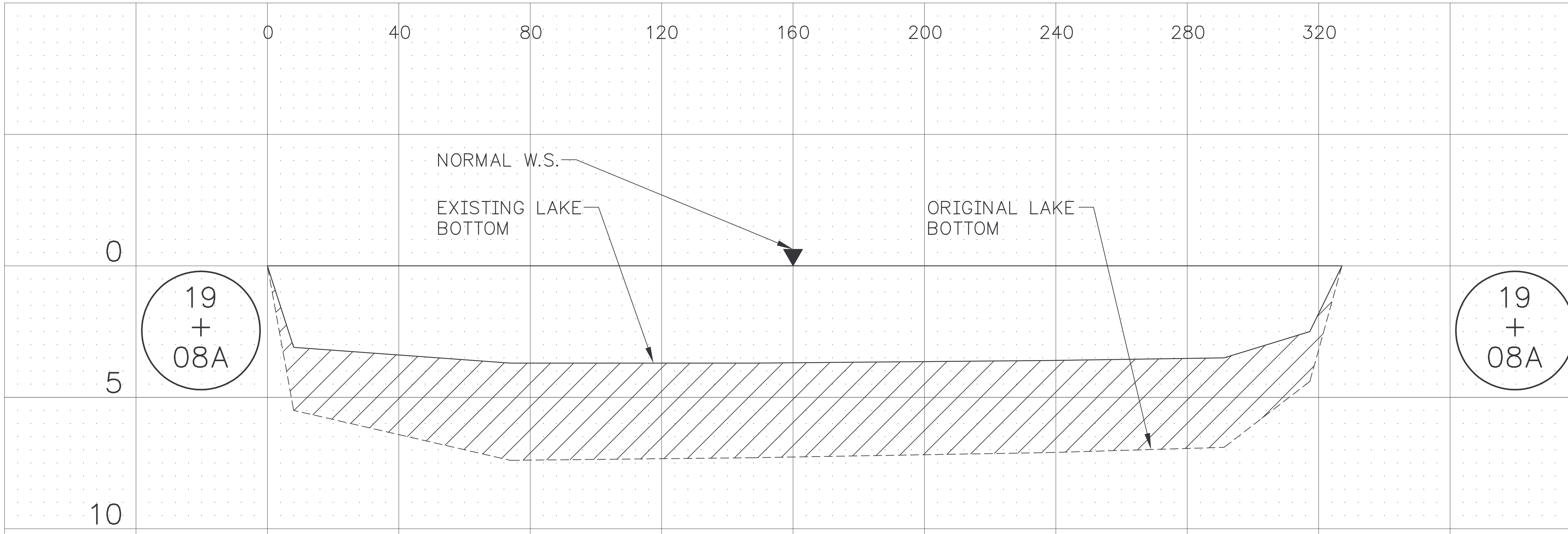


SEDIMENT AREA = 151 S.F.
WATER AREA = 101 S.F.
ORIGINAL BOTTOM AREA = 252 S.F.

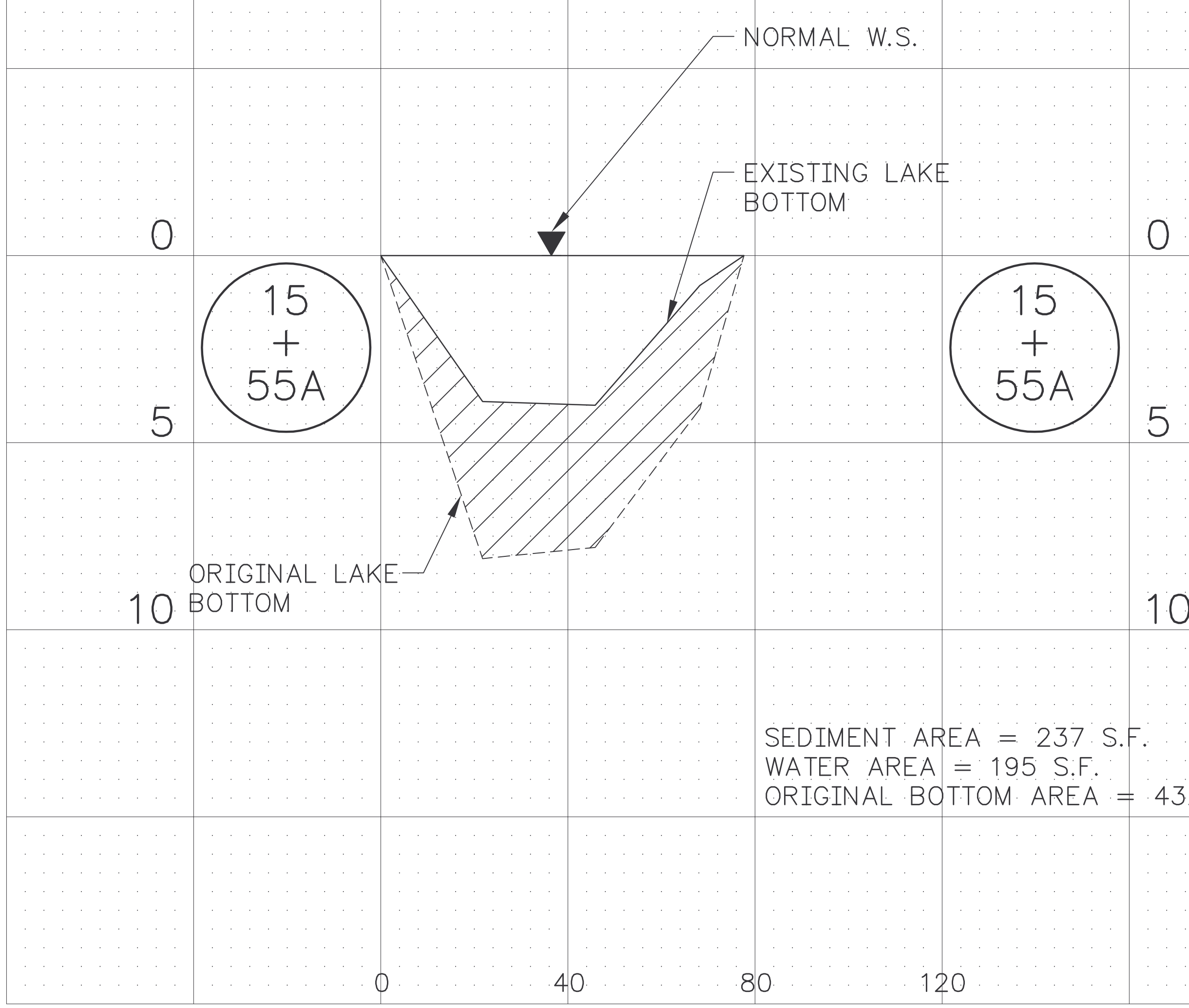
SCALE 1" = 40' HORZ.
1" = 5' VERT.


DUNLAP LAKE
CROSS SECTIONS
STA. 8+23A TO 13+14A
10 + 67A
NORMAL W.S.
EXISTING LAKE BOTTOM
ORIGINAL LAKE BOTTOM
SEDIMENT AREA = 92 S.F.
WATER AREA = 68 S.F.
ORIGINAL BOTTOM AREA = 160 S.F.
13 + 14A
SEDIMENT AREA = 361 S.F.
WATER AREA = 293 S.F.
ORIGINAL BOTTOM AREA = 654 S.F.
8 + 23A
SEDIMENT AREA = 120 S.F.
WATER AREA = 106 S.F.
ORIGINAL BOTTOM AREA = 226 S.F.
12 + 22A
NORMAL W.S.
EXISTING LAKE BOTTOM
ORIGINAL LAKE BOTTOM
SEDIMENT AREA = 119 S.F.
WATER AREA = 97 S.F.
ORIGINAL BOTTOM AREA = 216 S.F.
SCALE 1" = 40' HORZ.
1" = 5' VERT.
C–9

DUNLAP LAKE
CROSS SECTIONS
STA. 15+55A TO 19+08A



SEDIMENT AREA = 1065 S.F.
WATER AREA = 1121 S.F.
ORIGINAL BOTTOM AREA = 2186 S.F.

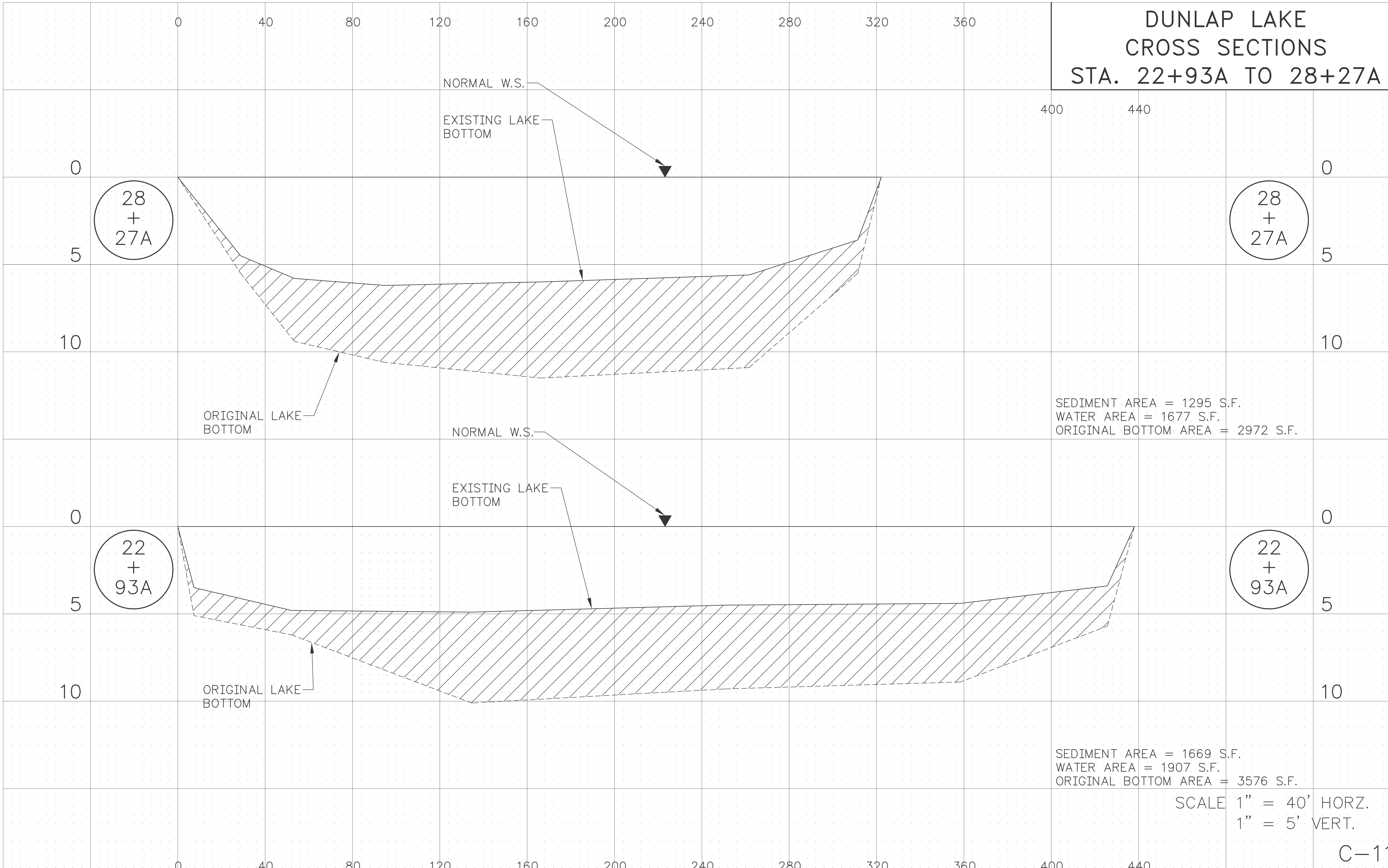


SEDIMENT AREA = 237 S.F.
WATER AREA = 195 S.F.
ORIGINAL BOTTOM AREA = 432 S.F.

SCALE 1" = 40' HORZ.
1" = 5' VERT.

C–10

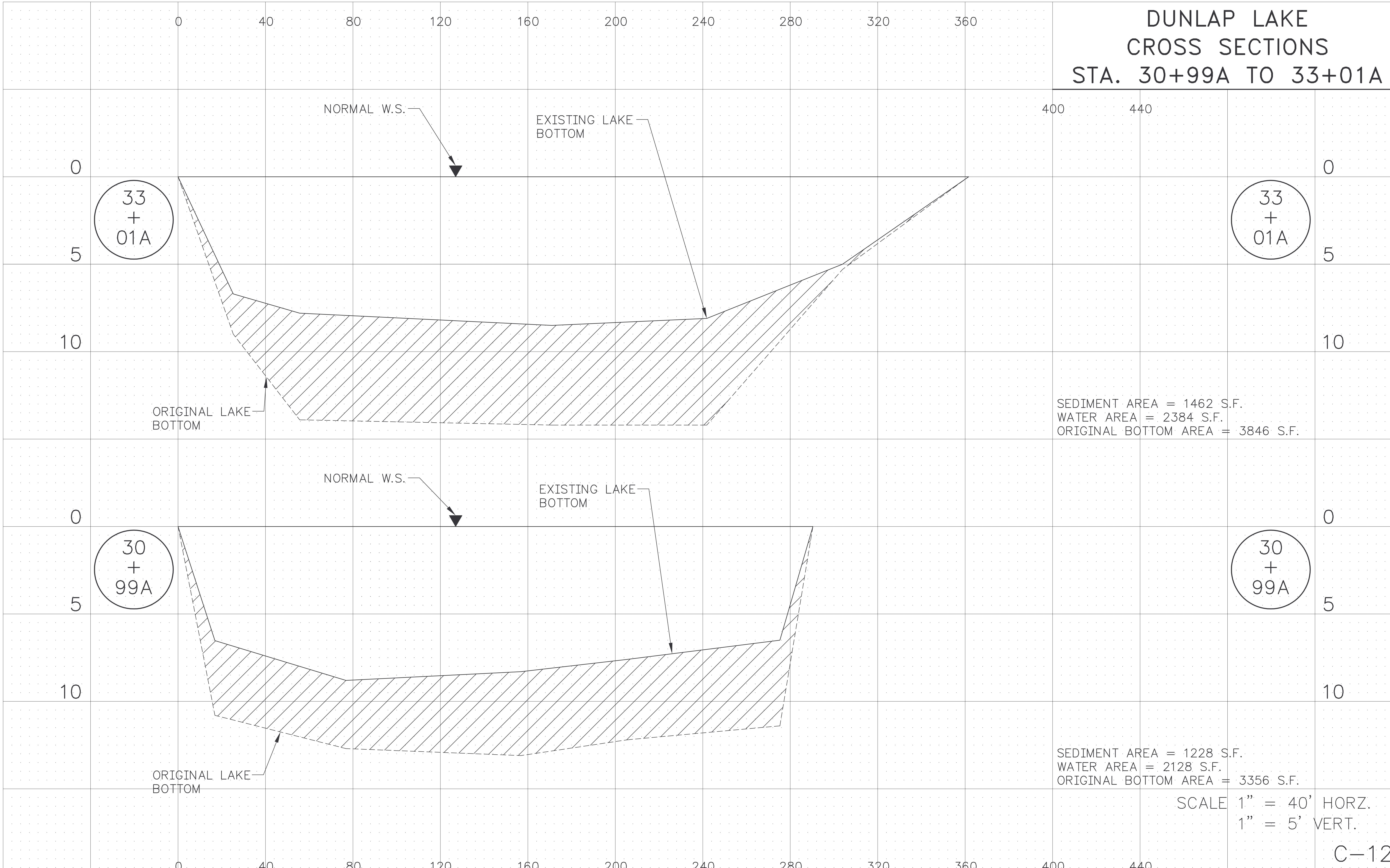
DUNLAP LAKE
CROSS SECTIONS
STA. 22+93A TO 28+27A



SCALE 1" = 40' HORZ.
1" = 5' VERT.

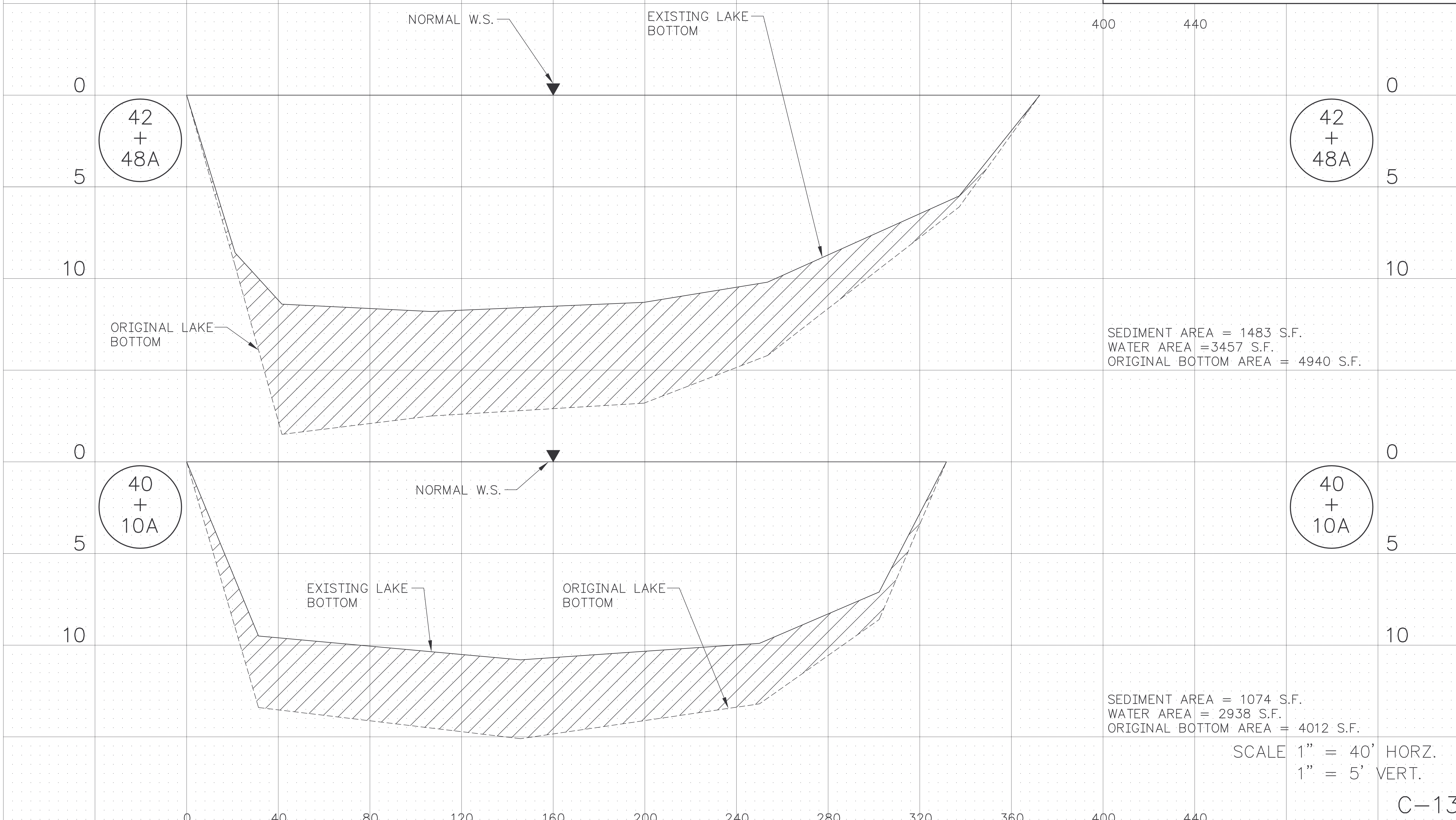
C–11

DUNLAP LAKE
CROSS SECTIONS
STA. 30+99A TO 33+01A



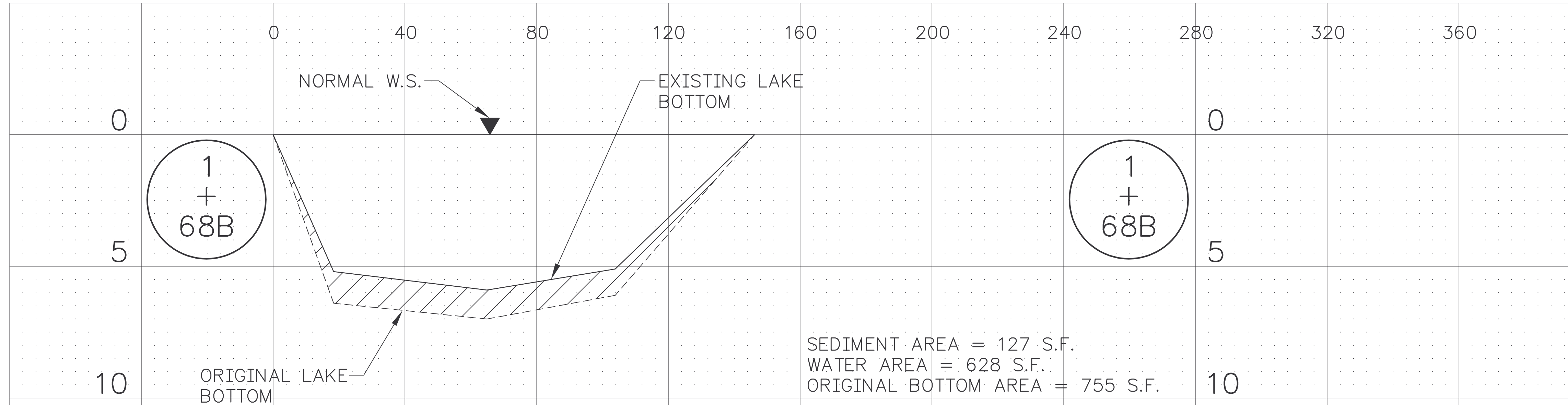
SCALE 1" = 40' HORZ.
1" = 5' VERT.

DUNLAP LAKE CROSS SECTIONS STA. 40+10A TO 42+48A

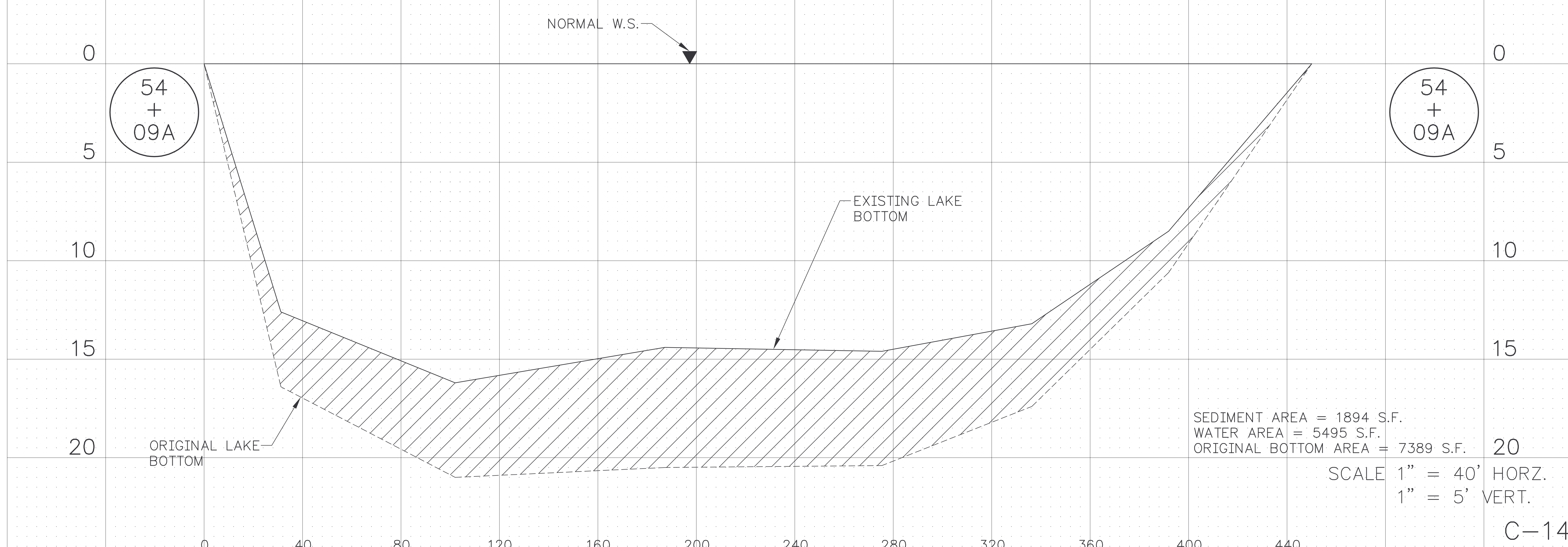


C–13

DUNLAP LAKE
CROSS SECTIONS
STA. 54+09A TO 1+68B



SEDIMENT AREA = 127 S.F.
WATER AREA = 628 S.F.
ORIGINAL BOTTOM AREA = 755 S.F.

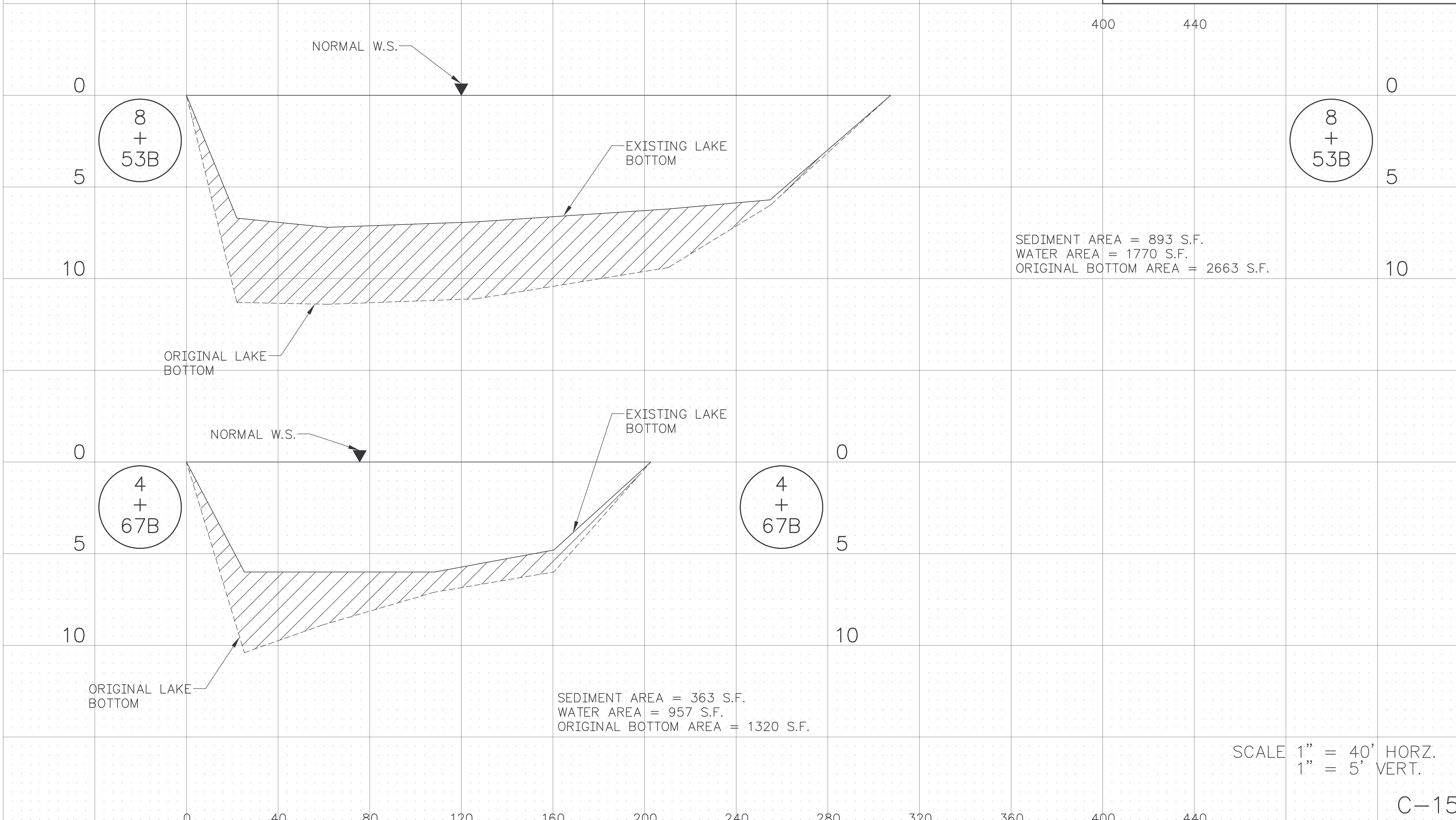


SEDIMENT AREA = 1894 S.F.
WATER AREA = 5495 S.F.
ORIGINAL BOTTOM AREA = 7389 S.F.

SCALE 1" = 40' HORZ.
1" = 5' VERT.

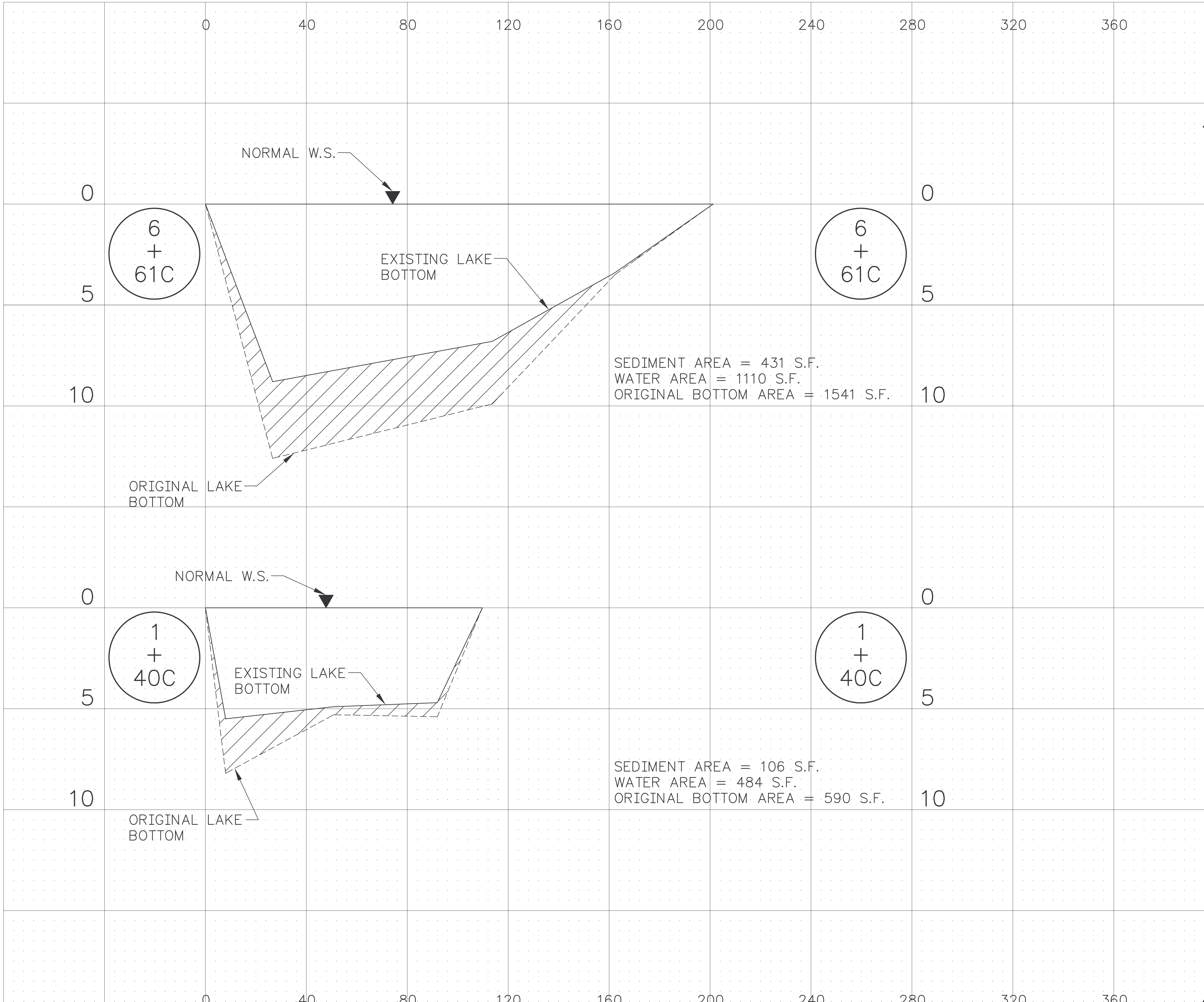
C–14

DUNLAP LAKE
CROSS SECTIONS
STA. 4+67B TO 8+53B



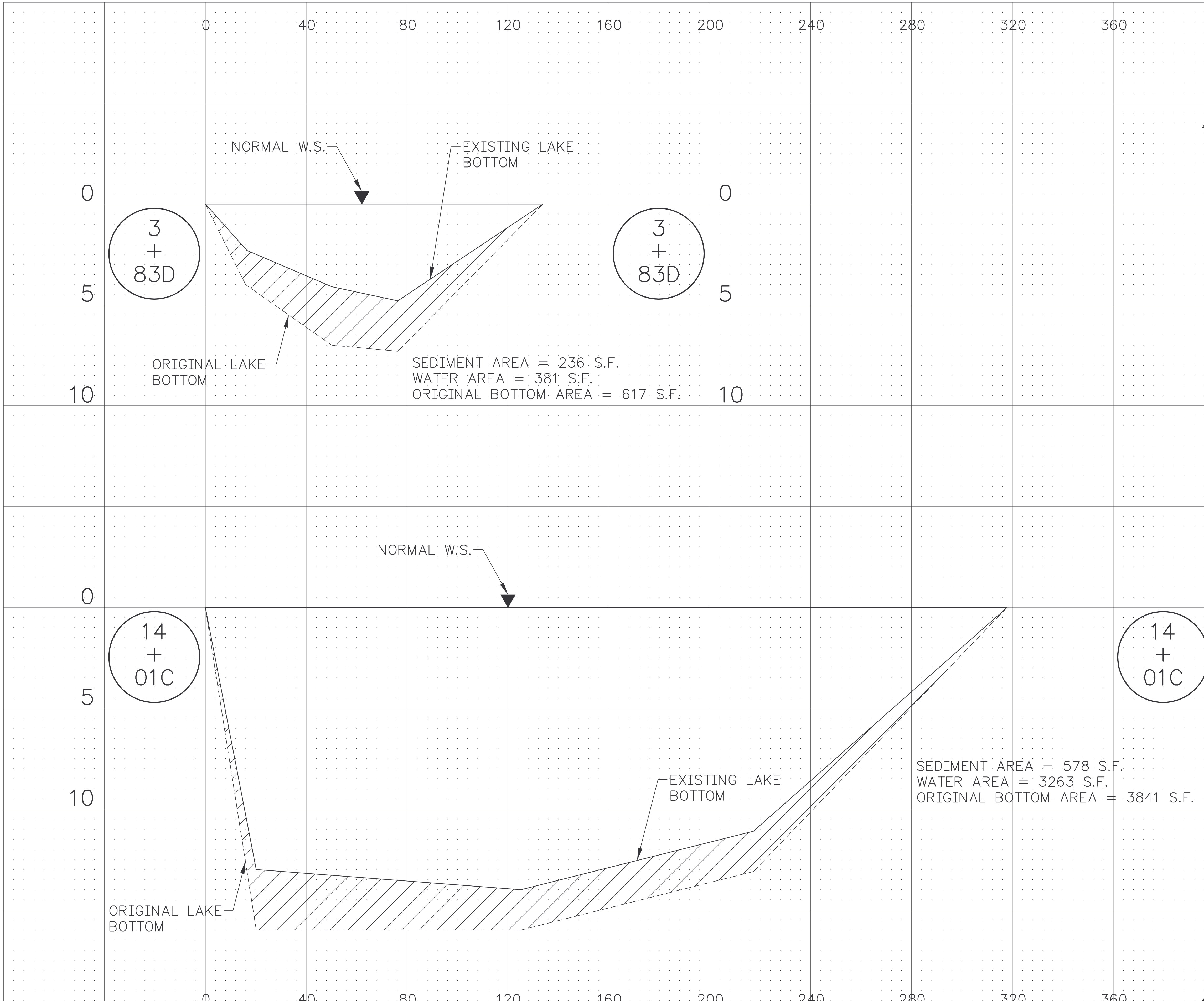
SCALE 1" = 40' HORZ.
1" = 5' VERT.

DUNLAP LAKE
CROSS SECTIONS
STA. 1+40C TO 8+61C



SCALE 1" = 40' HORZ.
1" = 5' VERT.

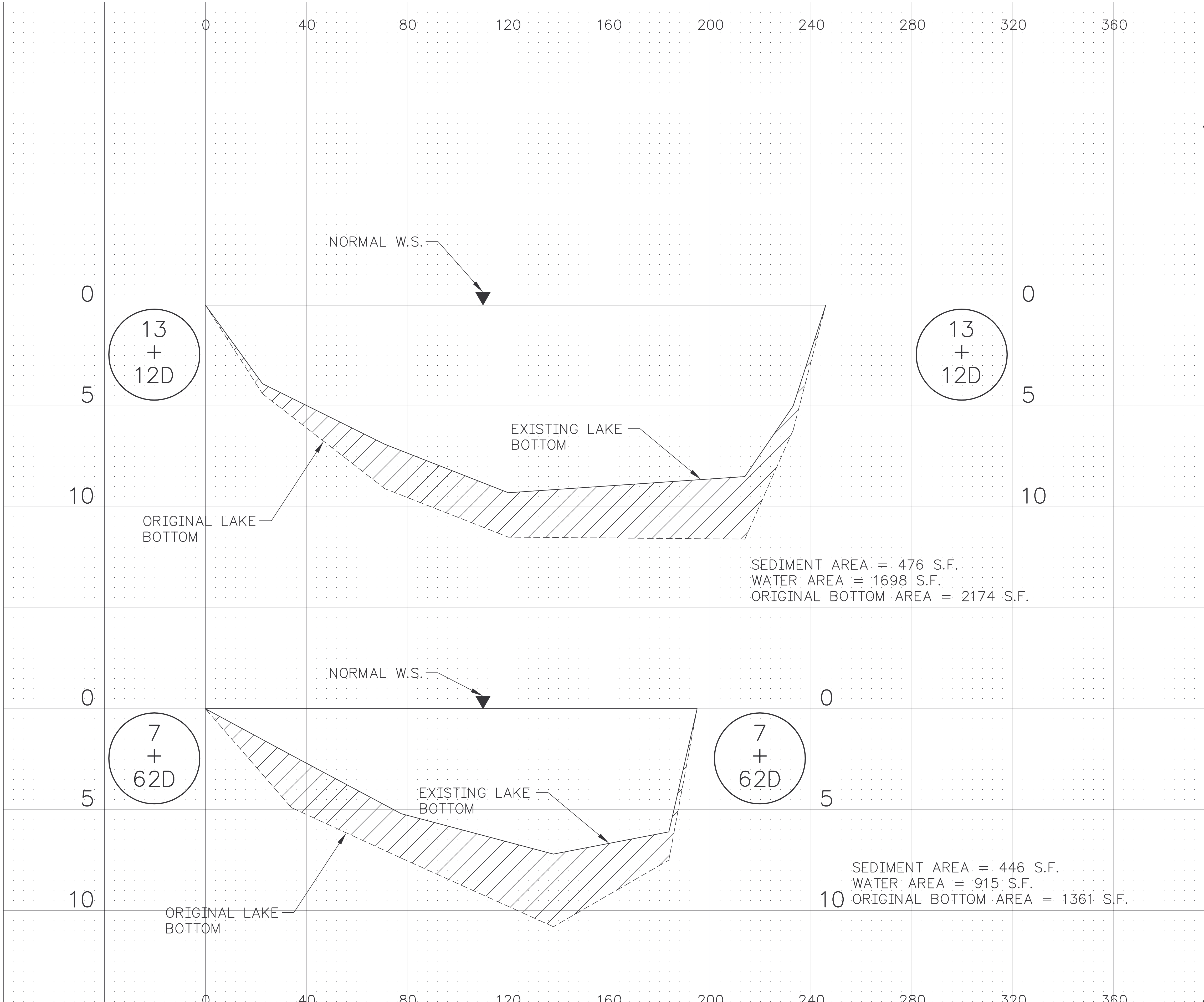
DUNLAP LAKE
CROSS SECTIONS
STA. 14+01C TO 3+83D



SCALE 1" = 40' HORZ.
1" = 5' VERT.

C–17

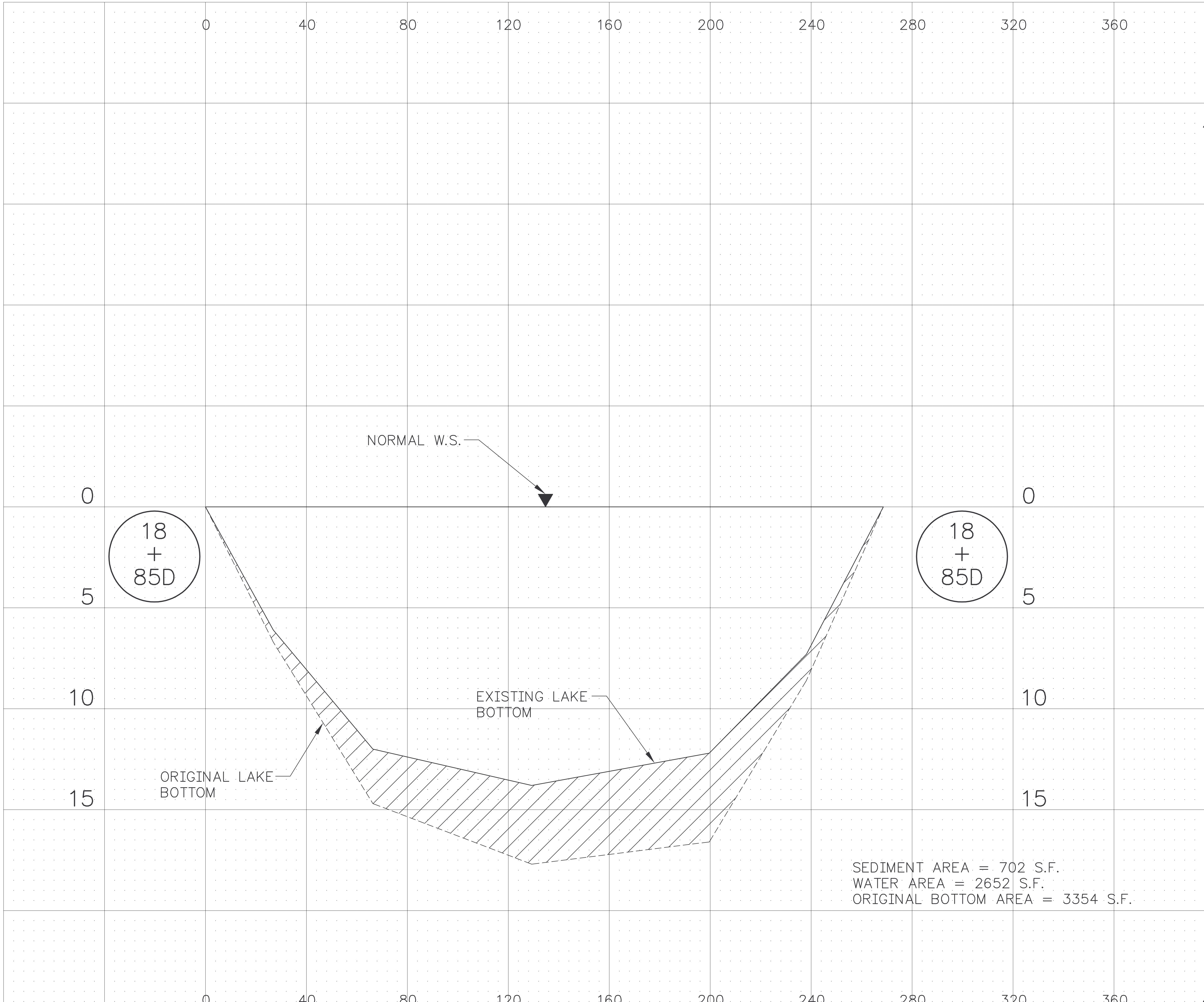
DUNLAP LAKE
CROSS SECTIONS
STA. 7+62D TO 13+12D



SCALE 1" = 40' HORZ.
1" = 5' VERT.

C–18

DUNLAP LAKE
CROSS SECTIONS
STA. 18+85D



SCALE 1" = 40' HORZ.
1" = 5' VERT.

C–19