Feasibility Study

Replacement of Beaver Lake Outlet

Prepared for
Ramsey-Washington Metro Watershed District

June 2005

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1.0 Introduction

Beaver Lake is located in eastern Ramsey County. The Lake straddles the city limits of St. Paul and Maplewood. The Minnesota Department of Natural Resources (DNR) identifies Beaver Lake as Lake No. 62-16 in Sec 25-26, T29N, R22W with an area of 64 to 65 acres. The location of Beaver Lake is shown in Figure 1.

The existing outlet is a drop box structure approximately 6-foot square which provides the inlet for a 36-inch diameter reinforced concrete pipe. This drop box structure and 36-inch concrete pipe form the headwater for the Beaver Lake Branch of the Beltline Interceptor system. The drop box structure includes a horizontal tubular steel grate which serves as a trash rack.

The existing steel grate collects significant quantities of floating debris. This debris commonly results in significant restriction to the flow through the steel grate. The structure also requires frequent maintenance to remove the debris collected upon the steel grate. The purpose of this study is to determine the feasibility of modifying or replacing the existing outlet structure to prevent or substantially reduce the flow restriction due to accumulated debris and reduce the maintenance issues related to the debris. Photographs of the existing outlet structure are attached to this report.

2.0 Existing Conditions

The existing outlet structure for Beaver Lake consists of a drop box inlet structure. The structure is 6 feet wide and extends into the lake a distance of 5 feet. The drop box structure is the inlet for a 36-inch diameter reinforced concrete pipe. A sketch of the drop box inlet structure is shown in Figure 2.

The drop box inlet structure includes a horizontal tubular steel grate which serves as a trash rack. The existing steel grate collects significant quantities of floating debris. This debris commonly results in significant restriction to the flow through the steel grate. This horizontal trash rack collects extraordinary quantities of debris which substantially restricts the flow of water through the grate.

The drop box inlet structure also includes removable stop logs. It appears that the stop logs could be removed to lower the level of the lake. The existing stop logs appear to be in fair condition.

Under existing conditions it is estimated that during high flow events, the capacity of the trash rack is restricted to approximately one-third of its' unobstructed capacity by debris accumulation. A site survey was performed in March 2005. The survey as shown in Figure 3 used the 1929 datum..

The DNR conducted a lake survey for Beaver Lake in September, 1993. A copy of the DNR's lake survey is included in Appendix A. The lake survey used the 1912 datum. Adjusting for the different datum there appears to be a discrepancy of about 0.6 of a foot between the 1993 and the 2005 surveys. The DNR's 1993 survey reflects elevations that are about 0.6 feet lower than the 2005 survey performed for this report.

The 1993 DNR lake survey indicates an ordinary high water (OHW) level of 950.8 (1912 datum). Based on the March, 2005 survey, after adjusting for the different datum and the discrepancy between the two surveys, the comparable OHW would be Elevation 951.1 (1929 datum).

A 36-inch diameter reinforced concrete pipe exits the drop box outlet structure to the south under Stillwater Avenue. This pipe forms the upstream end of the Beaver Lake Branch of the Beltline Interceptor storm sewer. The critical peak flows in the Beltline Interceptor occur as a result of short duration runoff events (generally less than 2-hour duration storms). Long duration runoff events (10-day snowmelt event) have no measureable impact on critical flows in the Beltline Interceptor downstream of Beaver Lake. For example, for the 2-hour duration storm event the peak outflow from Beaver Lake is only 24 cubic feet per second (cfs) compared to 55 cfs for the 10-day event

(which is the critical peak event for Beaver Lake). Even a 20 percent reduction in the 24 cfs rate (5 cfs) would have negligible impact on peak flow rates in downstream reaches of the Beltline Interceptor given that the peak outflow from Beaver Lake occurs many hours after the peak flows in the Interceptor. Therefore, no hydraulic modifications to the Beaver Lake outlet are warranted.

3.0 Alternatives Considered

Several alternatives were considered for the Beaver Lake outlet. These alternatives included:

- No Action
- Modify Existing Structure
- New Structure
- Amenities

These alternatives are discussed in the following sections of this report.

3.1 No Action

With this alternative no action would be undertaken at the Beaver Lake outlet. The existing conditions would remain undisturbed. It would be anticipated that the existing high level of maintenance related to debris removal from the trash rack would continue. The normal water levels and the ordinary high water (OHW) level would remain unchanged. Flood levels would also remain unchanged. There is no capital cost for implementation of this "no action" alternative; however, frequent cleaning of the trash rack will continue to inflate maintenance costs..

3.2 Modify Existing Structure

For this alternative the existing structure would be modified to reduce the accumulations of debris and eliminate the hydraulic restriction caused by the debris accumulations. This alternative would significantly reduce the high level of maintenance related to debris removal from the existing trash rack. The existing drop box inlet structure appears to be structurally adequate and serviceable for continued long-term use. The modifications would involve fitting the existing drop box structure with a more effective and efficient trash rack. The sloped configuration of the modified trash rack would reduce the flow restricting accumulations of debris. It is expected that the normal water levels and the ordinary high water (OHW) level would remain unchanged. However, it is anticipated that reduced restriction of the outlet by debris would result in lower 100-year flood levels on Beaver Lake.

A sketch of the modified trash rack is presented in Figure 3. The estimated cost for implementation of this alternative is $35,000.

3.3 New Structure (Restrictive)

For this alternative the existing drop box structure would be removed and replaced with a new structure. The configuration of the new structure would be designed to produce outflow rates comparable to those for the existing structure when restricted by debris. The new structure would, however, include a trash rack which would reduce the accumulation of debris during periods of higher flows. It is expected that the normal water levels and the ordinary high water (OHW) level would remain unchanged. It is anticipated that the configuration of the new structure would maintain the existing 100-year flood levels on Beaver Lake.

A sketch of the new structure and trash rack is presented in Figure 4. The estimated cost for implementation of this alternative is $127,000.

3.4 New Structure (Non-Restrictive)

For this alternative the existing drop box structure would be removed and replaced with a new structure. The configuration of the new structure would be similar to the existing structure. The new structure would include the trash rack described in the "Modify Existing Structure" alternative. The modified trash rack would reduce the accumulations of debris and would be more effective and efficient. The sloped configuration of the modified trash rack would reduce the flow restricting accumulations of debris. The modified trash rack would significantly reduce the high level of maintenance related to debris removal from the existing trash rack. The new structure would extend the service life of the outlet to 3 or 4 times the expected service life of the existing drop box structure. It is expected that the normal water levels and the ordinary high water (OHW) level would remain unchanged. However, it is anticipated that reduced restriction of the outlet by debris would result in lower 100-year flood levels on Beaver Lake.

A sketch of the new structure and trash rack is presented in Figure 5. The estimated cost for implementation of this alternative is $116,000.

3.5 Amenities

This alternative is not intended to be a stand alone alternative. Rather, this alternative is intended to be combined with other alternatives to address considerations for the Beaver Lake outlet other than the hydraulic structure.

This alternative includes placing two park benches facing the lake between the existing paved trail and the waters edge. These benches would be used to enjoy the aesthetic view of the lake and as a rest area for trail users.

A dedicated canoe landing area would be designated. The designated area would be landscaped to facilitate access to the waters edge and vegetated with species resistant to the foot traffic such a landing would receive. Appropriate signs would indicate the designated canoe landing area.

The entire area surrounding the outlet structure between Stillwater Avenue and the waters edge would be vegetated with grasses, flowers, and plantings. The shoreline would stabilized to facilitate use by canoeists and people using the area for fishing. The goal would be to enhance the aesthetics of this scenic location along the existing trail. It is assumed that Staff would design this portion of the work. The installation would be completed by a contractor retained by the District.

The estimated cost for implementation of this alternative is $24,000.

4.0 Recommended Alternative

The existing drop inlet structure at the outlet to Beaver Lake appears to be in adequate structural condition. This structure functions adequately except for the significant accumulations of debris which restrict flows and require frequent maintenance to remove the debris. The existing structure appears to be capable of providing continued service for 20 to 25 years except for the issue related to the trash rack.

The recommended alternative is to modify the existing structure in combination with the amenities alternative. The remaining service life of the existing structure combined with the relatively low cost of modifying the existing structure were major factors considered. The amenities will enhance the aesthetics and related uses for this water resource structure. The estimated cost of this recommended alternative is $60,000.

The recommended alternative will result in a lower flood level for the critical 100-year runoff event. The design of the modified trash rack for the structure will reduce or eliminate the accumulations of debris that currently restrict the outflow during flood events. A reasonable expectation for the modified trash rack would be about 25 percent restriction during a flood event. The existing trash rack can be expected to experience a restriction of about 66 percent during a similar flood event. The final design of the modified structure should include performing hydrologic analyses to establish the 100-year flood level for the improved structure.

It is not expected that the recommended alternative will change either the normal (runout level) or the ordinary high water (OHW) for Beaver Lake. None the less permits would be required from the DNR for this work.

Photographs

Photo 1 – Beaver Lake Outlet (View facing east)

Photo 2 – Beaver Lake Outlet (View facing north)

Photo 3 – Beaver Lake Outlet (View facing west)

Photo 4 – Beaver Lake Outlet (close-up facing lake)

Figures

Source: USGS 7.5' Quadrangle, St. Paul East, MN and Lake Elmo, MN 1967 Photorevised 1993

N

0 2000 4000

Approximate Scale in Feet

QUADRANGLE LOCATION

Figure 1

LOCATION MAP
BEAVER LAKE OUTLET

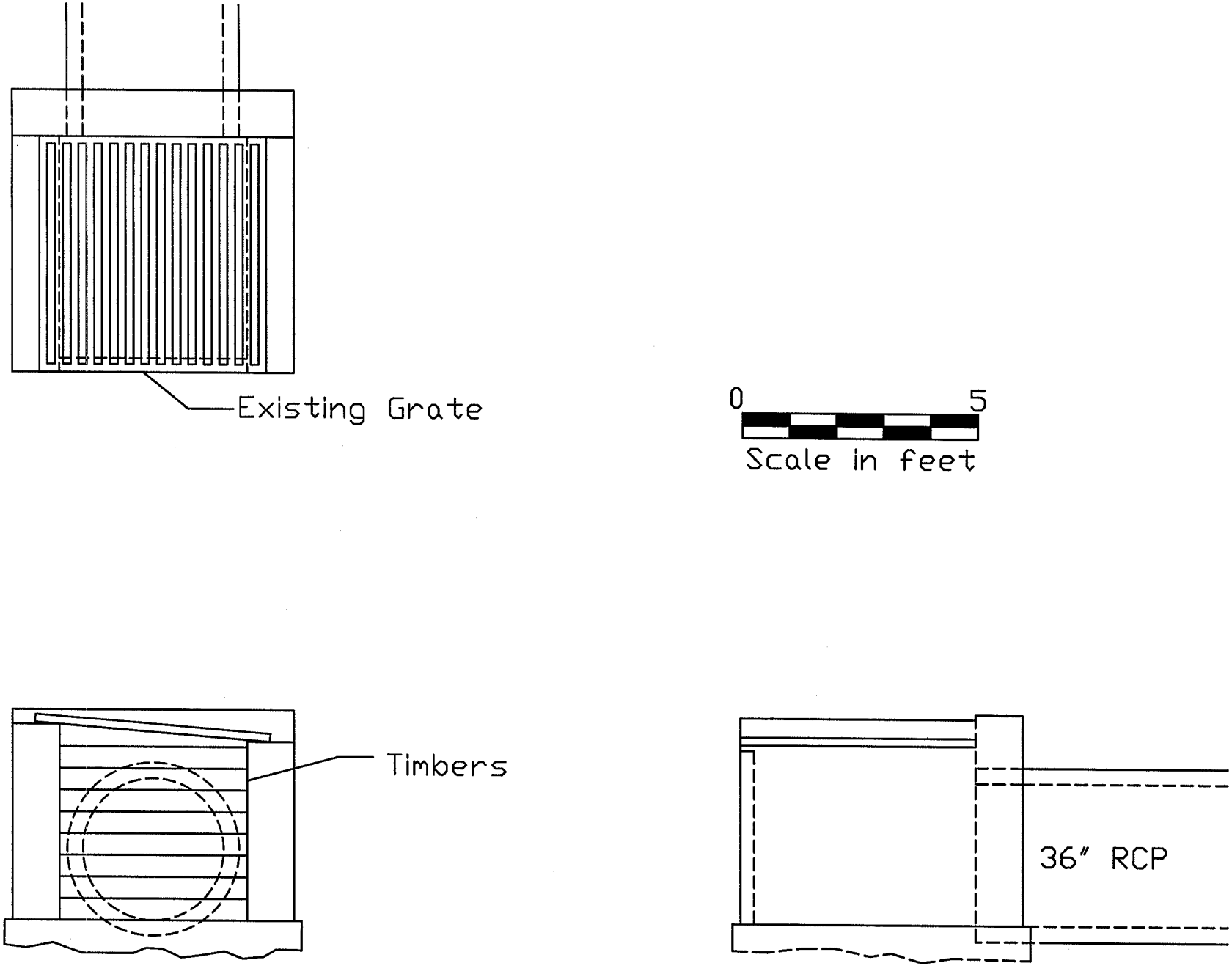

Figure 2 - Existing Structure

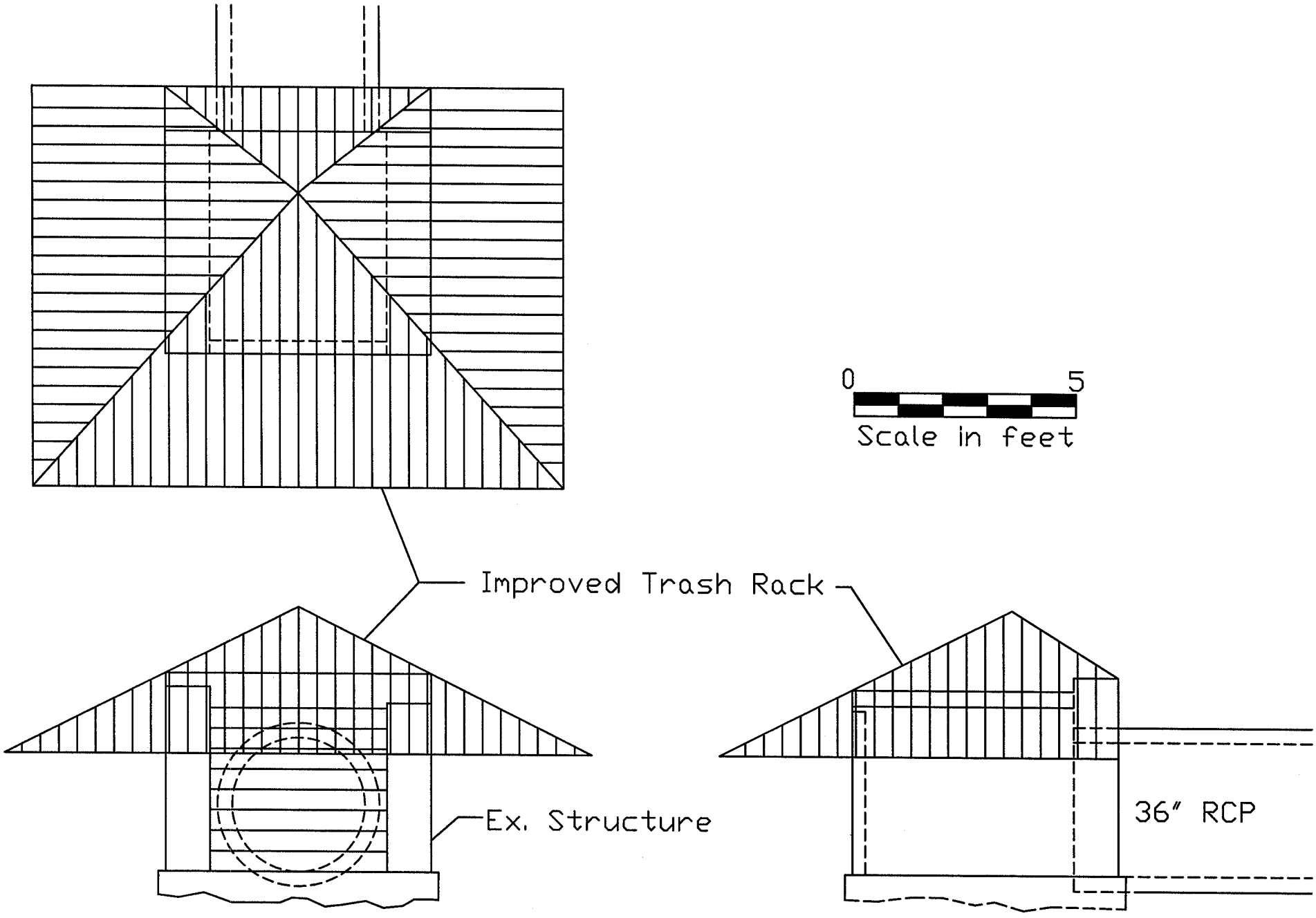

Figure 3 - Modified Trash Rack

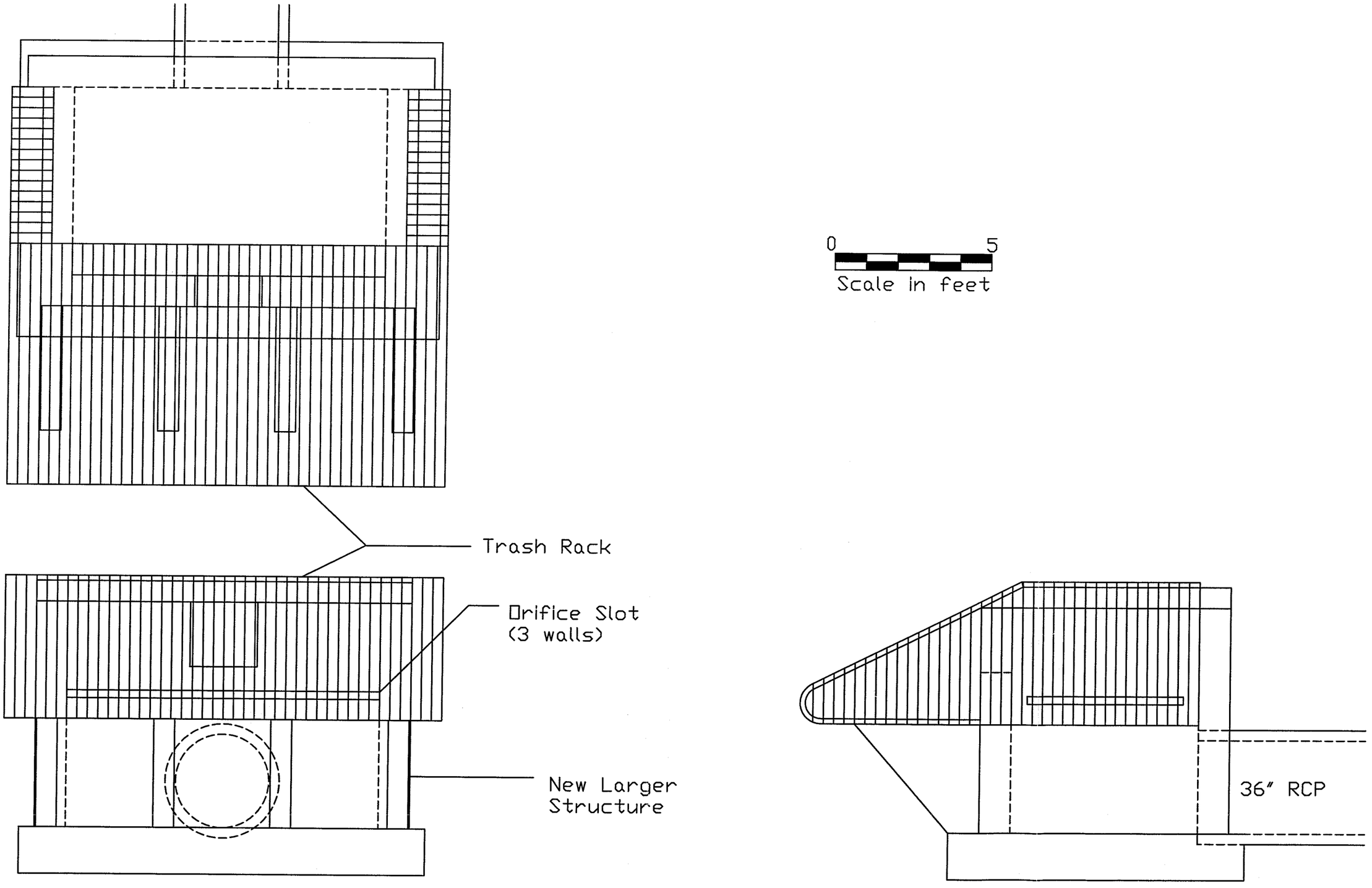

Figure 4 - New Structure Restrictive

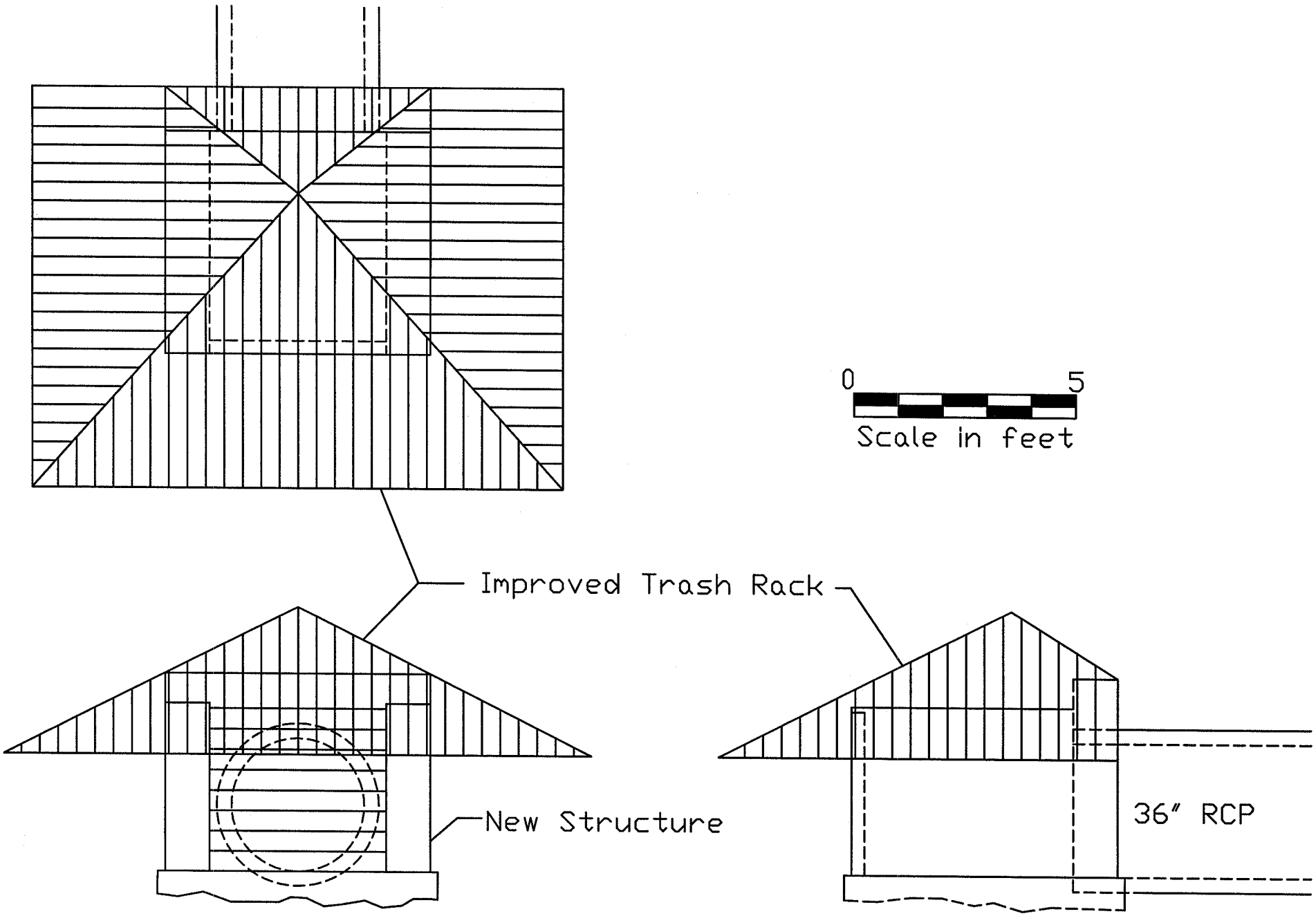

Figure 5 - New Structure (Non-Restrictive)

Appendices

Appendix A

Lake Survey, September 1993
Minnesota Department of Natural Resources

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Post-it® Fax Note 7671 | Date 4/26/05 | # of pages ▶ 2
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NA-02630-02
Rev. 3/92

Department of Natural Resources
Division of Waters

Project			Lake No.
Beaver Lake			62-16
City: St. Paul	County: Ramsey		Req. No.: 94-13
Sec.: 25,26	Twp.: 29	Rng.: 22	Watershed: Metropolitan

SURVEY DATE: 9/8 & 9/15/93
SURVEY CREW: Scherek, Moll, Woodrich

LAKE SIZE
Meandered Area 64 Acres ☐ Non-meandered
Planimetered Area 65 Acres ☐ Unknown

DATUM ADJUSTMENT
☐ Assumed ☒ 1912 ☐ 1929 ☐ 1988 Source: Ramsey County

CONTROL BENCHMARK
Location: at outlet structure on SW side of lake (NW-NE-SE, Sec. 26-29-22)
Elevation: 951.64
Description: top centerline of concrete headwall of outlet structure

SURVEY WORK COMPLETED
☒ levels ☐ topography ☐ cross sections ☐ profiles ☒ OHW
☐ establish benchmarks ☒ outlet elevations ☐ other:

WATER LEVELS
Highest Recorded: 953.40, 7/1/75
Lowest Recorded: 946.30, 10/25/55
Range: 7.10' (1348 water levels between 4/20/55 and 7/7/93)
Water Surface: 950.93, 9/8/93
OHW Elev: 950.8
Highest Known:

OUTLET
General Description: at SW side of lake (NW-NE-SE, Sec. 26-29-22) via a drop inlet structure with stoplogs into a 36" R.C.P. which runs underground to the south

Runout Elevation & Description: 950.30, top of stoplogs

SEP 1993
RECEIVED
REGION VI
WATERS

BENCHMARKS SET
Location:
Elevation:
Description:

Location:
Elevation:
Description:

Prepared By: John M. Scherek TMS | Title | Date

The O.H.W. level of the lake is based on the average reduced elevation of the 18 best trees of the 19 which we documented (oak, elm, cottonwood & aspen). We also recorded a washline at 951.4 and a distinct stainline on a tree at 951.5. The previously determined O.H.W. level of 948.6 was indicative of conditions prior to the existing outlet structure and is no longer relevant.

Following are the elevations we found on the outlet structure:

Top of left wingwall of dam	951.00
Top of left stoplog slot	950.89
Top left end of stoplogs	950.30
Centerline of stoplogs	950.32
Top right end of stoplogs	950.32
Top of right stoplog slot	950.88
Top of right wingwall	951.00
Sill of dam	947.46
Upstream invert of 36" R.C.P.	947.12

Note: We observed a pile of debris (mostly vegetation) lying on the road slope adjacent to the structure, which appeared to have been recently removed from the structure.