Owasso Basin Optimization Design Report

Prepared for
Ramsey-Washington Metro Watershed District

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1.0 Background

Owasso Basin, located in Little Canada, MN, west of Country Drive and north of Owasso Boulevard (Figure 1), is a regional storm water facility designed and constructed by the Ramsey-Washington Metro Watershed District (District) in the early 1990s. The Basin was constructed to provide 88 acre-feet of flood storage to alleviate local flooding problems in the North Star Estates Mobile Home Court (Mobile Home Court) and the surrounding area.

Owasso Basin receives drainage from approximately 970 acres, the majority of which originates east of I-35E. Of those 970 acres, approximately 216 acres are directly tributary to Owasso Basin. The local watershed is primarily characterized by "light industrial" land use and is occupied by several small warehouse-type buildings with expansive gravel parking lots immediately adjacent to the Basin. The local drainage area also includes the highly impervious Mobile Home Court located along Owasso Basin's southern edge. Currently, there are no water quality ponds or facilities to pre-treat runoff from the local watershed prior to discharge into Owasso Basin.

Fra-Dor, a concrete and asphalt recycling operation owned by Frattalone Companies, occupies the parcel immediately north and adjacent to Owasso Basin. This site is characterized by large stockpiles of concrete and bituminous rubble in various stages of the recycling process. The Fra-Dor site is in a constant state of flux, with a steady flow of demolition material entering and leaving the site. This situation leaves very little opportunity for vegetation to become established on or near the stockpiles. The stockpiles are immediately adjacent to Owasso Basin with only a narrow, sparsely-vegetated buffer between the toe of the stockpiles and the water's edge.

As mentioned, the primary purpose of Owasso Basin is flood control. However, during the bidding phase of the Owasso Basin construction project, an opportunity surfaced that allowed a water quality component to be added to the Basin design at minimal additional cost to the project. That water quality component resulted in an additional four feet of depth being excavated throughout the center portion of the Basin to provide 17 acre-feet of dead storage. Although this dead storage depth/volume was less than the 38 acre-feet needed to achieve the District's treatment standards (60% total phosphorus (TP) removal and 85% total suspended solids (TSS)), the dead storage was still expected to remove 40% of the TP loading and 65% of the TSS loading into the pond based on the ratio of surface area to drainage area (Barr 1996).

Recent monitoring and modeling efforts (discussed in Section 2.0) have shown that Owasso Basin is not achieving these expected levels of treatment, and the poorer-than-expected water quality leaving

the Basin is reducing the effectiveness of the downstream treatment facilities. Optimizing Owasso Basin's performance would result in a reduction of phosphorus loads reaching the Phalen Chain of Lakes.

2.0 Monitored Basin Performance

During the summer and fall of 1995, extensive monitoring was performed to measure the total phosphorus (TP) and total suspended solids (TSS) loading into, and out of, Owasso Basin. Analysis of the monitoring results showed that the treatment efficiency of Owasso Basin is being adversely affected by either:

1) the runoff from the industrial areas by-passing the deeper portion of the Basin (short-circuiting), or

2) internal phosphorus loading from the Basin's bottom sediments being released into the Basin water.

The data was inconclusive as to the relative contribution from each of the possible sources and the report recommended additional monitoring to determine the primary source of the pollutants (Barr 1996).

In 2003, the 1995 monitoring data was analyzed in further detail. The evaluation involved assessing the 1995 monitoring data using the "P8 Urban Catchment Model", which was calibrated to match the observed monitoring data. For this study, the local watershed to Owasso Basin was broken down into 10 separate drainage areas (as shown on Figure 2), eight of which have a distinct direct inflow point into the Basin. The 2003 study also analyzed the potential for sediment re-suspension from wind mixing, anoxic sediment phosphorus releases, and scour during high runoff events as reasons for the Basin's performance being below expectations (Barr 2003). The results of this study ruled out internal phosphorus loading from bottom sediments as a primary phosphorus source. This conclusion left short-circuiting of inflows from the local watershed as the most likely cause of the Basin's poor performance. A recent site visit to view the areas and their close proximity to the outlet channel further justified the conclusion.

3.0 Phalen Chain of Lakes Strategic Lake Management Plan

Owasso Basin is part of the Gervais Creek (a.k.a. County Ditch 16) watershed that is tributary to Gervais Lake. Gervais Lake is one of four lakes that make up the Phalen Chain of Lakes. Figure 1 shows Owasso Basin's location within the Gervais Creek watershed. In 2004, the District completed the Phalen Chain of Lakes Strategic Lake Management Plan (SLMP). The Phalen Chain SLMP serves as a guidance document to protect the Phalen Chain of Lakes. This detailed watershed and in-lake water quality study listed numerous recommendations for action that will help protect and improve the water quality of the Phalen Chain. Specifically, recommendation "GE-2" of the SLMP suggests optimizing the performance of Owasso Basin by eliminating short-circuiting of flows from the Basin's local watershed.

3.1 Unweave the Weave (MnDOT's I-35E/I-694 Commons Project)

Embedded in recommendation GE-2 of the Phalen SLMP is an assumption that flows originating east of I-35E would be pre-treated prior to entering the Owasso Basin local watershed. The Minnesota Department of Transportation (MnDOT) plans to begin a major highway reconstruction project to "Unweave the Weave" of the I-35E and I-694 commons area immediately east of Owasso Basin. As part of the reconstruction project, MnDOT will be constructing a series of water quality treatment ponds that will treat all runoff from this area prior to entering the Owasso Basin local watershed. MnDOT representatives have worked with the District through the design phase of the project to ensure the ponds achieve the District's current 60% TP and 85% TSS removal standards. The MnDOT project, recently permitted by the District, is expected to begin in 2006.

In addition to providing water quality treatment, the MnDOT ponds are expected to provide substantial peak flow attenuation. The reduction in peak flows entering the Owasso Basin's local watershed from the east will reduce the flood storage requirements of Owasso Basin and provide the District with more options to improve the water quality of discharges from Owasso Basin.

4.0 Design Strategy

As a primary element of the design strategy, any proposed water quality improvements to Owasso Basin must allow the Basin to continue to function for flood relief. Therefore, before any improvements are recommended, it is important to first understand how the existing drainage system functions.

4.1 Existing Drainage System

Runoff from the Owasso Basin watershed, east of I-35E, drains from the western intersection of I-35E/I-694 into a small pond situated between Country Drive and the southbound lane of I-35E, shown on Figure 3. Two pipes currently drain this small pond. On the north end of the pond is a 36-inch diameter high density polyethylene pipe (HDPEP) with an upstream invert at Elevation 867.8. The HDPEP drains west under Country Drive to Owasso Basin. On the south end of the pond is a 72" x 115" reinforced concrete arch pipe (RCPA) with an upstream invert at Elevation 867.9. This RCPA drains west under Country Drive to a drainage ditch that runs along the southern perimeter of the Mobile Home Court. A concrete weir structure with a crest at Elevation 870.9 was constructed as a part of the Owasso Basin project on the upstream end of the Country Drive RCPA. This concrete weir diverts low flows from the drainage area east of I-35E to the HDPEP and into Owasso Basin for treatment. High flows overtop the concrete weir and bypass Owasso Basin in the drainage ditch.

Runoff from the local watershed enters Owasso Basin from all directions. The primary flow from the local watershed enters Owasso Basin through a culvert in Ryan Drive, in the northwestern "arm". Storm sewer pipes, draining the industrial area west of the Basin, discharge into the Basin at several locations. Also, runoff from Fra-dor, as well as other adjacent parcels with little or no vegetation, drains overland through sparsely-vegetated buffers directly into the Basin.

Owasso Basin discharges to a drainage ditch along the west side of the Mobile Home Court. This ditch converges with the ditch on the southern perimeter of the Mobile Home Court and drains under Owasso Boulevard into Gervais Creek via a 72" x 115" RCPA. The invert elevation of the Owasso Boulevard RCPA (Elevation 866.7) serves as the normal water level of Owasso Basin. During high runoff events, the Owasso Boulevard RCPA restricts flows and forces water to back-flow up the west ditch and into Owasso Basin where it is stored until the peak flows have passed.

As mentioned, the center portion of the Basin is approximately four feet deep. This additional depth/volume serves to slow flows through the Basin to allow sediments and particulate phosphorus

to settle out. The original design assumed that the low flows from the drainage area east of I-35E would always enter the Basin untreated. Therefore, the deeper pool in the center was added to address this situation. Shallow areas along the western side, in the northeast arm, and the southeast arm were designed to allow vegetation to reestablish and provide a wider buffer for the local watershed areas. However, vegetation did not reestablish along the western side of the Basin and, therefore, little buffer exists in that area. This results in little treatment of flows from these areas.

4.2 Proposed Improvements

To date the flood storage function of Owasso Basin has met or exceeded the original performance expectations. Therefore, only modifications associated with improved water quality treatment performance are recommended. Those water quality improvements can be achieved through the implementation of a 2-phase improvement plan described below. Two phases are necessary, based on the current schedule of the MnDOT "Unweave the Weave Project". Phase I improvements will results in immediate water quality benefits, but will not meet the District's standard nor the recommendation of the Phalen SLMP. Phase II improvements can be completed after the MnDOT work is complete and will allow the Owasso Basin's water quality treatment component to achieve the desired results

Phase I Improvements

Phase I improvements focus on improving the water quality treatment effectiveness of Owasso Basin by:

1) Improving the quality of runoff entering the Basin from the local watershed, and

2) Increasing the detention time of the runoff from the local watershed while still providing some water quality treatment for the eastern watershed until the "Unweave the Weave" Project is complete.

To increase detention time for local drainage area flows, a steel sheet weir with a crest at Elevation 870.0 should be installed in the Mobile Home Court perimeter drainage ditch approximately 15 feet west of the existing RCPA under Owasso Boulevard. The general location is shown in Figure 4. A 12-inch diameter orifice with an invert at Elevation 866.7 should be cut into the steel sheeting. The weir and small orifice would slow the discharge from Owasso Basin, forcing the Basin's water level to rise up quickly to Elevation 870 during a rain event. At this elevation, a minimum of four feet of standing water would exist throughout the Basin. This water depth would slow flows from all of the local drainage area, allowing sediments and particulate phosphorus to settle out in the Basin. The

small orifice would allow the Basin to draw down to its normal water elevation after the rain event to preserve the Basin's existing flood storage. Peak flows in the drainage ditch above Elevation 870 could still back-flow over the proposed weir and utilize the available flood storage in Owasso Basin. This proposed weir/orifice configuration would enhance the Basin's water quality treatment effectiveness, but would not adversely impact the existing 100-year peak flood elevation of the Basin.

The downstream side of the steel sheet weir should be fortified with erosion control. A 3-foot deep sump spanning the width of the existing ditch and extending 10 feet downstream from the weir should be excavated and lined with geotextile filter fabric. A 1-foot deep layer of Class I riprap should cover the filter fabric. Class III riprap should then be used to bring the sump to existing grade at Elevation 866.7.

On the north side of Owasso Basin, the District should work with Frattalone Companies to improve the runoff from their site and enhance buffer between the Fra-Dor stockpiles and Owasso Basin. Based on past conversations with Frattalone, it is understood that concrete rubble was buried to a depth of approximately 25 feet along the southern edge of the site to provide soil stability for their operations. There may be an opportunity to infiltrate runoff from the Fra-dor site into the voids of the buried rubble, without compromising its original purpose. Another option is to construct a drainage ditch along the southern perimeter of the site, line the ditch with an appropriate filter gravel, and direct all of the runoff to a common collection point, preferably on the west side. These options should be pursued with Frattalone as a part of the Phase I improvements. If these options are not feasible or acceptable to Frattalone, Frattalone should, at a minimum, install silt fence along the southern and western perimeter of the Fra-dor site and actively maintain the silt fence for the duration of their operations.

The existing buffer between the Fra-Dor site and Owasso Basin should be completely removed and replaced. Topsoil should be placed along the slopes to a minimum depth of 3 inches. The disturbed surfaces should then be seeded with an aggressive native grass species such as switch grass and covered with mulch blanket. This restoration effort should be pursued with Frattalone as well, since the need for it is a direct result of the Fra-dor operations.

Ryan Lane and Ryan Drive, located just west of the northwest arm of Owasso Basin are in a constant state of disrepair. The poor local soils and frequent truck traffic result in cracks and potholes in the roads. The broken chunks of asphalt become pulverized into fine particles by local traffic, fine particles are washed out of the potholes and runoff carries the particles into Owasso Basin. The District should work with the City of Little Canada to develop a plan for the improvement and

increased maintenance of these roads. The improvements may include higher design standards for the roads, sump manholes with an aggressive maintenance program, increased street sweeping in the area, and/or the installing structural pretreatment devices in the roadway.

On the west side of Owasso Basin, pre-treatment facilities should be installed to remove particulates, oil and grease from the runoff of the industrial areas' gravel lots. This could be achieved by installing structural sediment removal facilities such as grit chambers or engineered treatment structures such as "Stormceptors" at the existing catch basin locations. There is an opportunity to provide up to four of these facilities on the west side of Owasso Basin. A fifth facility could be installed in the northwest corner of the Mobile Home Court, if the final design warrants it.

There are a number of proprietary systems that could potentially achieve the pretreatment goals. A cursory list companies that manufacture pre-treatment facilities, and a description of their products, is included in Table 1. Some of the vendors of these facilities are getting aggressive in the marketing of their products and may be willing to donate a facility in order to begin a working relationship with the District. This should be pursued with willing and appropriate vendors. Monitoring the effectiveness of these facilities should be incorporated into the District's annual storm water monitoring plan.

It should be noted that these pre-treatment systems currently are not on an approved list from the MPCA to meet NPDES Phase II permit requirements. Applicants proposing these systems have many hoops to jump through when using these systems in an attempt meet permit requirements. The use and monitoring of these systems at the Owasso Basin site could help in a statewide effort to develop a "pre-approved" list for wide-spread use. It is likely that grant money may be available for an effort such as this.

The berm on the west side of Owasso Basin was constructed from soils excavated from Owasso Basin. The berm was constructed to provide flood protection to the adjacent businesses. Some settlement was expected as a part of using those soils and periodic maintenance was anticipated. As part of the Phase I improvements, the District should survey the berm to determine the degree of settlement and should bring the berm to the planned elevation where necessary. In addition, the pipes that drain through the berm are equipped with flap gates to prevent Owasso Basin from back-flowing into their yards during flood events. These flap gates should be inspected to ensure functionality and, where necessary, should be replaced with more reliable check valves such as Redvalve's Tideflex check valves.

The recommended Phase I improvements are shown on Figure 4. Assuming the pre-treatment devices remove 50% of the total suspended solids as advertised, Owasso Basin is estimated to achieve 42% removal of TP and 90% removal of TSS.

Phase II Improvements

Upon completion of the MnDOT "Unweave the Weave" project, the existing diversion weir located on the upstream of the RCPA under County Drive should be removed to allow low flows originating east of I-35E to bypass Owasso Basin. Class II riprap should be placed on both sides of the steel sheet weir installed during Phase I. The riprap should extend from the crest of the weir to existing grade at a 3:1 slope.

By placing riprap on both sides of the orifice in the steel sheet weir, the flow capacity of the orifice would be reduced and the detention time of inflows from the local watershed would be increased. The Basin would still draw-down to the existing normal water surface elevation, but the draw-down time would be longer, allowing for more treatment.

The existing 36-inch diameter HDPEP located on the east side of the Basin would serve as a secondary outlet for the Basin. At elevations above 867.9, Owasso Basin would "backflow" west to east through the existing 36-inch diameter HDPEP, into the small pond between Country Drive and I35E. Flows would be forced south in the small pond and back west under the Country Drive RCPA into the drainage ditch along the south side of the Mobile Home Court and out through the Owasso Boulevard RCPA. At water surface elevations above 870.0 Owasso Basin would drain both through the HDPEP and over the steel sheet weir. A back flow prevention valve should be installed on the east end of the existing 36-inch diameter HDPEP that would allow Owasso Basin to discharge to the east and prevent other flows from entering the Basin.

The Phase II recommended improvements are shown on Figure 5. Once Phase II is complete, Owasso Basin would only be treating drainage from the local watershed. The Basin is estimated to remove 60% of the TP loading and 95% TSS loading once the Phase II improvements are implemented.. The additional ponding planned as a part of the MnDOT project will attenuate the peak flows such that the Phase II improvements that include the higher normal water elevation of Owasso Basin would not result in an increased 100-year flood elevation of the Owasso Basin.

5.0 Cost Estimate

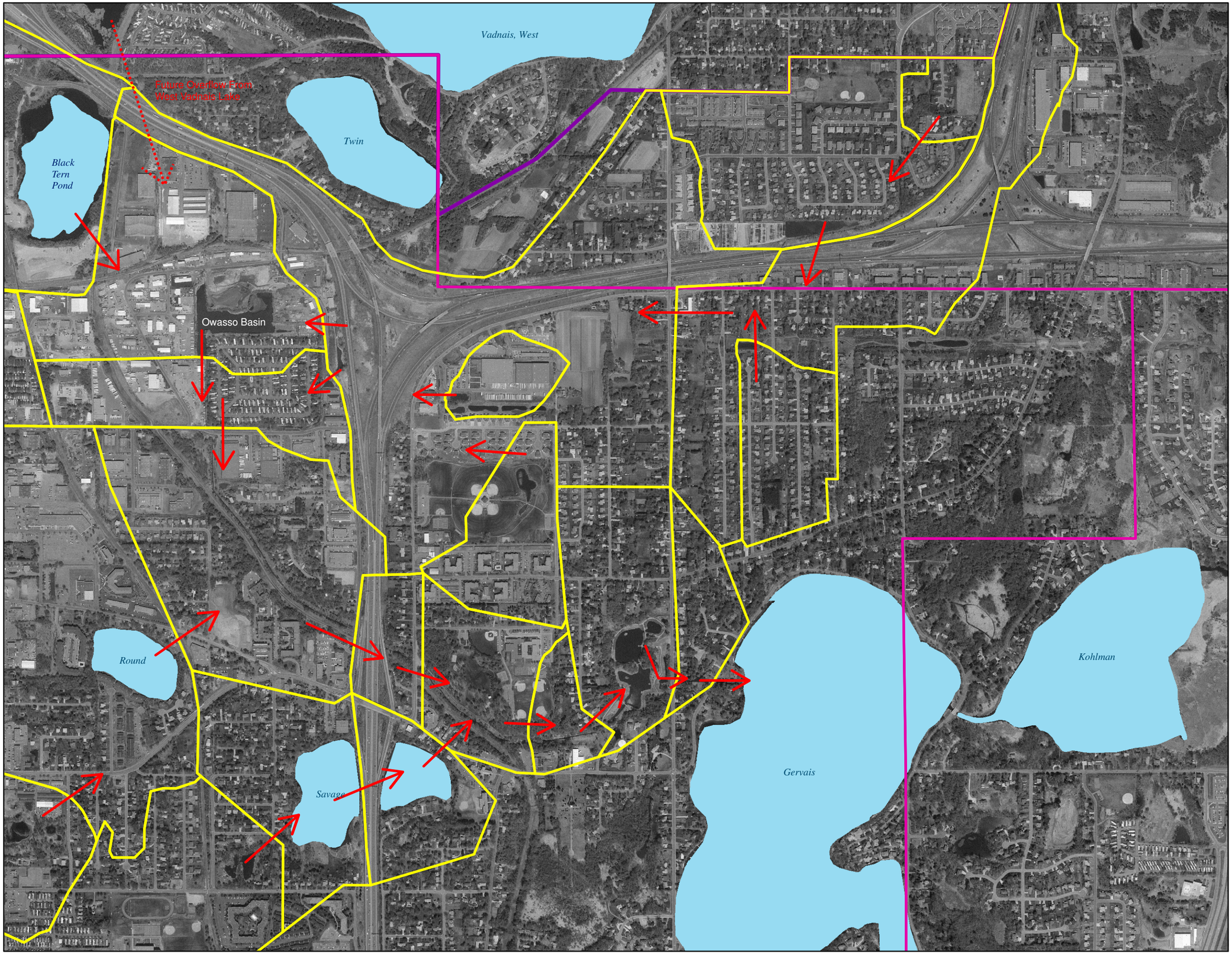
The estimated cost to design and construct the recommended improvements is $452,000. The implementation of the Phase I recommendations is estimated to cost $409,000, including engineering and contingencies. This number assumes the District would pay the full cost to furnish and install five engineered pre-treatment devices and none of the devices would be donated. The estimate includes the full estimated cost to improve the drainage and buffer at Fra-Dor; however Frattalone Companies will be asked to participate in the project.

The estimated cost to implement the Phase II recommendations is $43,000, including engineering and contingencies. Due to the nature of the Phase II elements, this work can be incorporated into the District's annual CIP Maintenance/Repairs project to further reduce costs.

TABLE 1: Structural Pre-treatment Facilities

Company	Products	Description
AquaShield	AquaSwirl	A single, modular unit constructed of HDPE that uses rotation to remove 80% TSS, oils and floatables.
BaySaver	Separation System	A diversion system that adds an additional manhole where flow is diverted for TSS, oils and floatables removal before returning to the original structure.
Best Management Products	Snout	Device attaches inside existing manholes and keeps out floatables and some oils and sediments. Very inexpensive.
CDS Technologies	CDS Unit	Single manhole-sized unit uses rotation and a screen to remove large particles and TSS. Some oils are also removed, more if sorbents are added.
EcoTechnic	EcoStorm	A single unit that uses rotational forces to remove 80% TSS. It also has an inner chamber for removal of oils and floatables. An Austrian company with a MN distributor.
Environment 21	V2B1	Two manholes in series with sediment removal in the first chamber, oils and floatables in the second. 80% TSS removed. Used in Wayzata and Fridley.
Fabco	StormCube	A large, rectangular system with three chambers for removal of TSS and oils. The system includes a filter bed.
Hydro International	DownStream Defender	A single, concrete chamber that uses rotational forces to remove 80% TSS, oils and floatables.
KriStar	FloGard Dual-Vortex Hydrodynamic Separator	A single manhole system that uses rotation to remove 80% TSS, oils and floatables. There are two rotational separators: one for low flow and one for high flow.
Park Environmental	StormTrooper	Two-manhole system that removes over 80% TSS and 90% oils. Has control structure to prevent scouring during high flows.
StormCeptor	In-line	A single, circular unit that removes 50-80% TSS, 60-95% oils, and floatables using rotational forces.
StormCeptor	Submerged	Very similar to the inline StormCeptor system, however, the submerged system allows up to 2 feet of tailwater.
Stormwater Management	StormGate Separator	This large rectangular system removes TSS, oils and floatables by gravity.
Vortechnics	Vortechs System	A multi-chambered rectangular system that removes TSS, oils and floatables through rotation. It is a robust system that has a large footprint.
Vortechnics	VortCapture	A single manhole that can remove up to 80% TSS and 100% of particles over 5mm.

Phase I Items	**Unit**	**Quantity**	**Unit Price**	**Extension**
Mobilization/Demobilization	LS	1	$20,000	$20,000
Soil Borings	Each	5	$1,000	$5,000
Clearing and Grubbing	LS	1	$5,000	$5,000
Erosion Control	LS	1	$5,000	$5,000
Dewatering	LS	1	$10,000	$10,000
Steel Sheeting	SF	300	$25	$7,500
Steel Sheet Orifice	LS	1	$750	$750
Filter Fabric	SY	50	$10	$500
Class I Riprap	CY	5	$75	$375
Class III Riprap	CY	10	$75	$750
Muck Removal	CY	15	$75	$1,125
Topsoil	CY	500	$12	$6,000
Berm Repair	LS	1	$5,000	$5,000
Mulch Blanket	SY	6500	$3	$21,125
Seeding	AC	2	$4,000	$8,000
Fra-Dor Pre-treatment	LS	1	$10,000	$10,000
Road Improvement Plan	LS	1	$5,000	$5,000
Structural Pre-treatment Facilities	Each	5	$25,000	$125,000
12-inch Diameter Redvalve Tideflex	Each	5	$5,000	$25,000
Subtotal				$261,125
Engineering				$92,500
Contingencies				$55,000
Phase I Total				$408,625
Phase II Items	**Unit**	**Quantity**	**Unit Price**	**Extension**
Mobilization/Demobilization	LS	1	$5,000	$5,000
Remove Concrete Diversion Weir	LS	1	$5,000	$5,000
36-inch Diameter Tidefles Redvalve	LS	1	$12,500	$12,500
Class II Riprap	CY	20	$75	$1,500
Subtotal				$24,000
Engineering				$9,600
Contingencies				$9,600
Phase II Total				$43,200
Total Project Cost				**$451,825**



Legend

- Municipal Boundary
- RWMWD Boundary
- Drainage Area
- Flow Arrows

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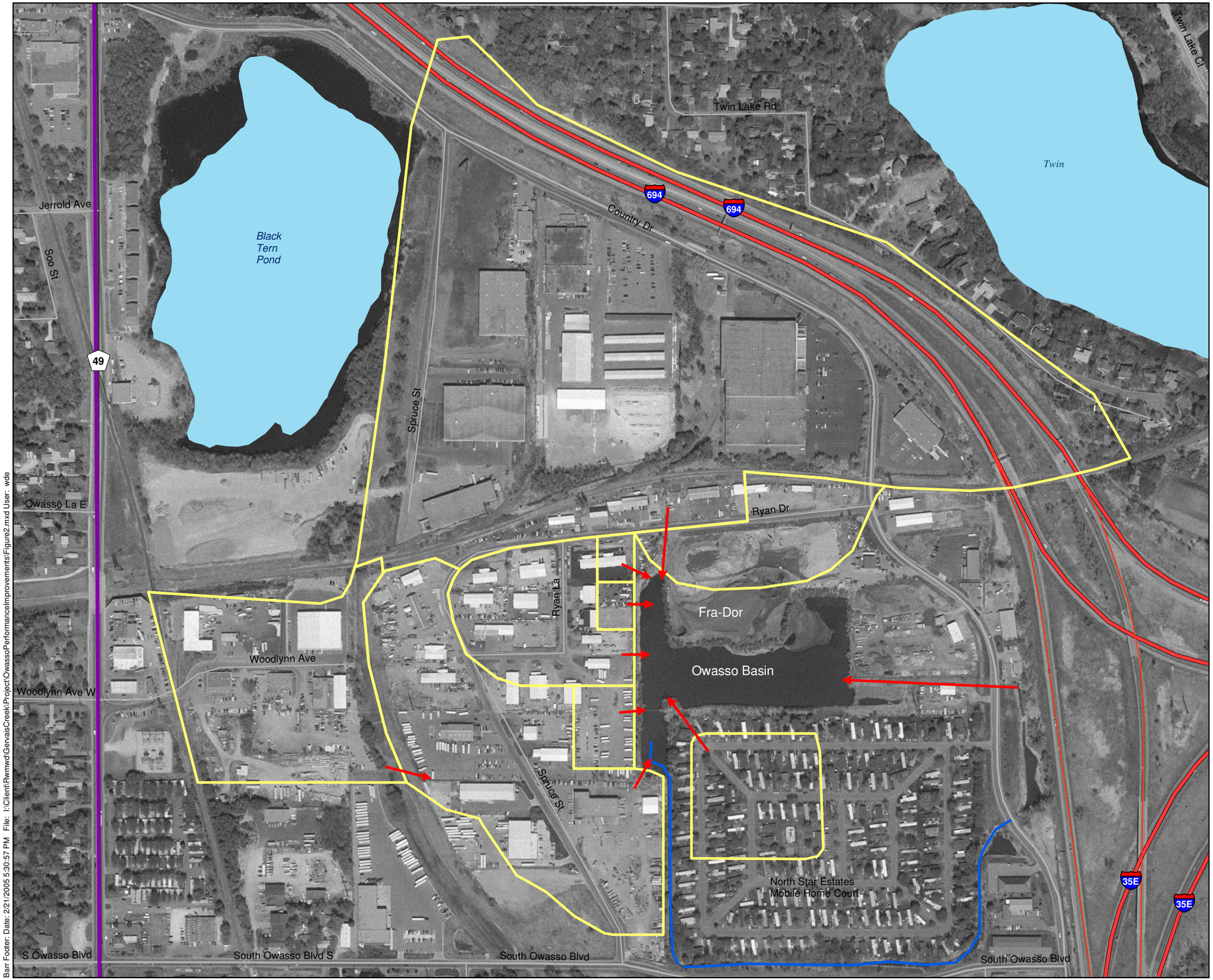
Figure 1

Gervais Creek Watershed
Owasso Basin Performance
Improvements Design Study
Ramsey-Washington Metro
Watershed District



Legend

- RWMWD Boundary
- Ditch
- Drainage Area
- Inflow Points

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400 200 0 400
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Figure 2

Existing Conditions
Owasso Basin Performance
Improvements Design Study
Ramsey-Washington Metro
Watershed District
North St. Paul, MN

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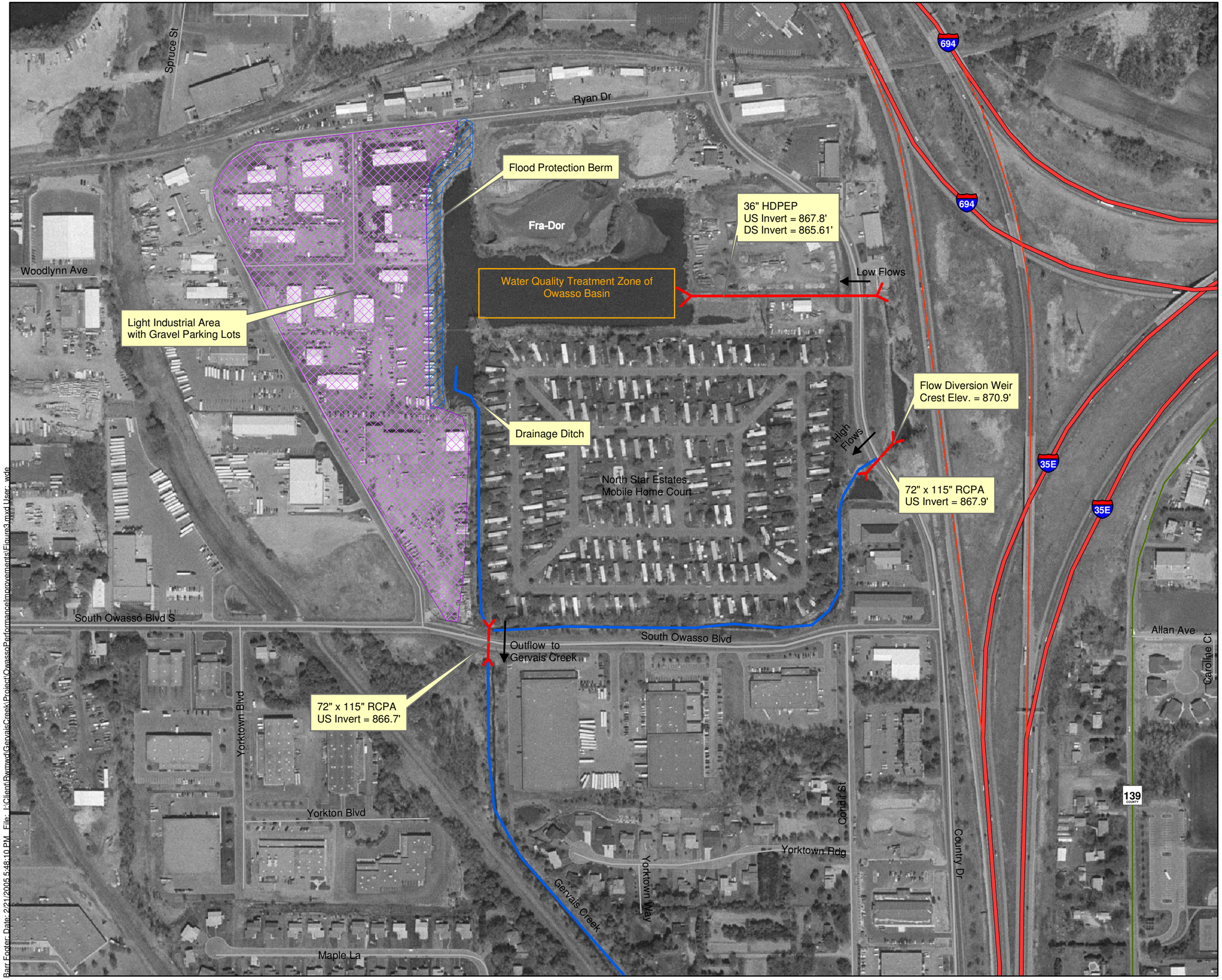

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Ditch

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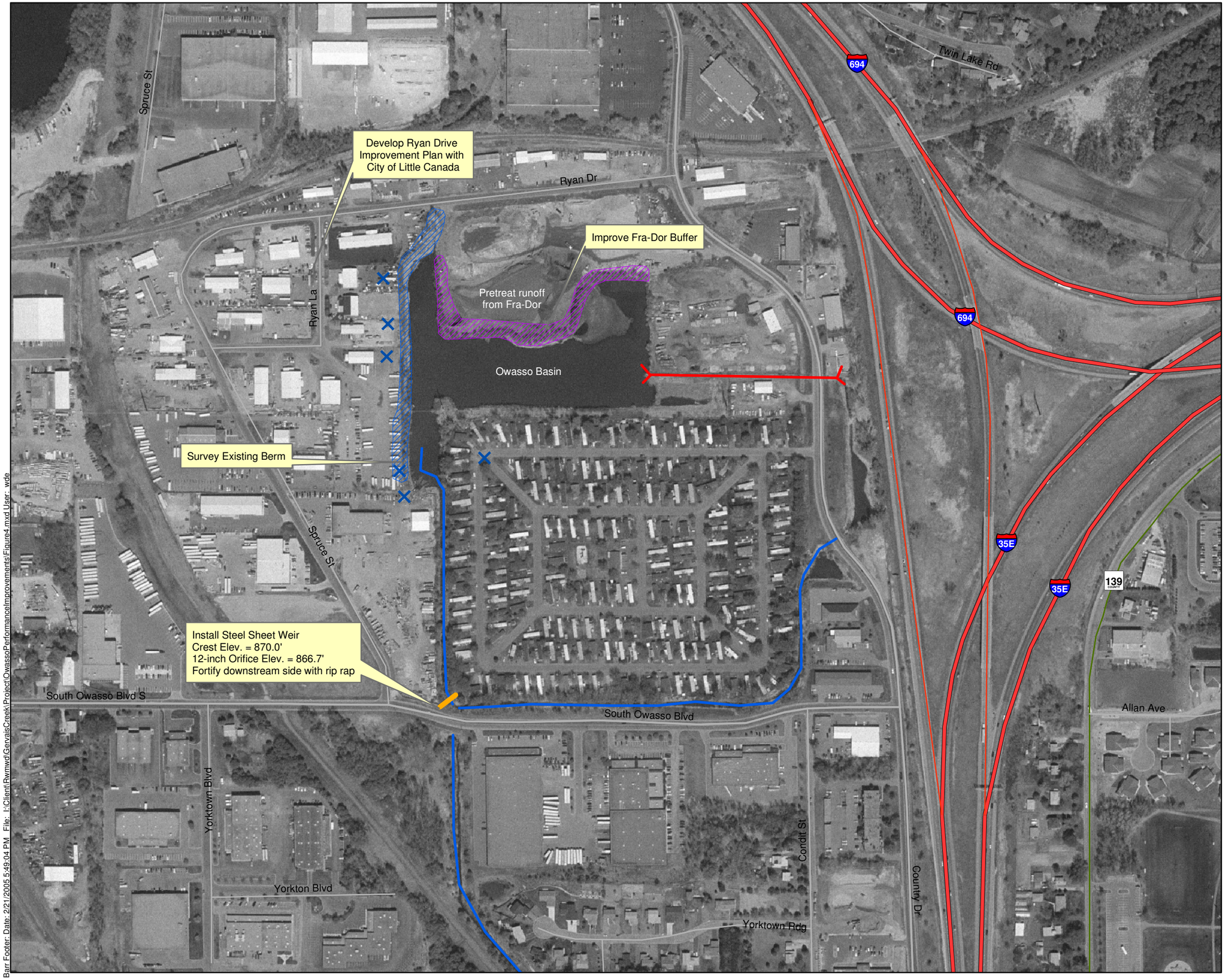
Figure 3

Existing Conditions
Owasso Basin Performance
Improvements Design Study
Ramsey-Washington Metro
Watershed District
North St. Paul, MN



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Ditch

Pre-treatment Facility

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Figure 4

Proposed Phase I Improvements
Owasso Basin Performance
Improvements Design Study
Ramsey-Washington Metro
Watershed District
North St. Paul, MN

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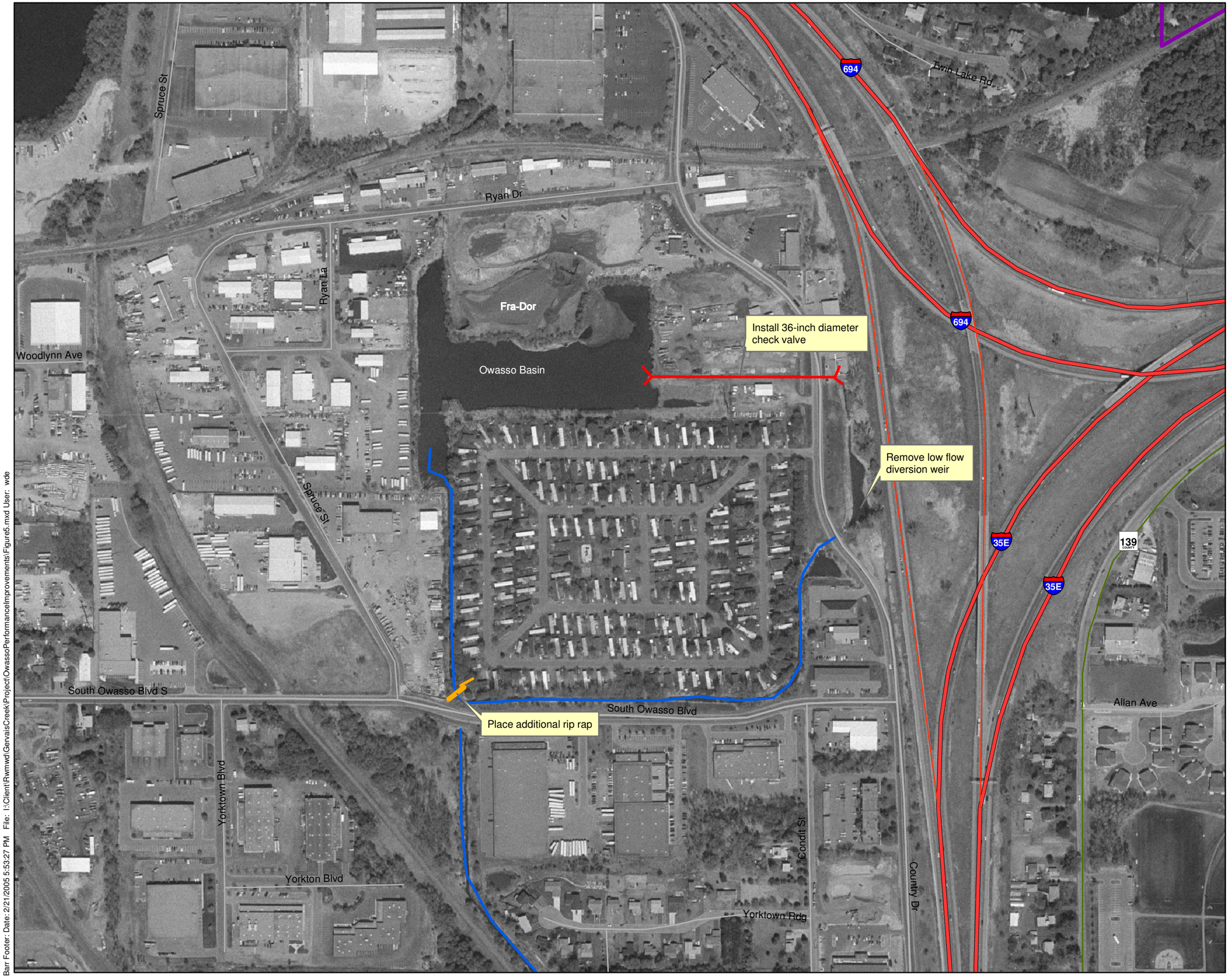

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Figure 5

Proposed Phase II Improvements
Owasso Basin Performance
Improvements Design Study
Ramsey-Washington Metro
Watershed District
North St. Paul, MN

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