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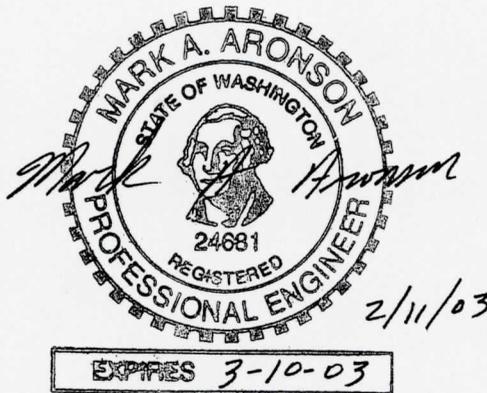
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**STORMWATER FACILITIES
OPERATION & MAINTENANCE MANUAL
For
TURTLE CREEK SOUTH, SECOND AND THIRD ADDITIONS**

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**STORMWATER FACILITIES
OPERATION AND MAINTENANCE MANUAL
for
TURTLE CREEK SOUTH, SECOND AND THIRD ADDITIONS**

I. Purpose

This Operation and Maintenance Manual is intended to provide general guidelines for maintaining the stormwater facilities built in conjunction with Turtle Creek South, Second and Third Additions. The proper operation and maintenance of these facilities will be the responsibility of Turtle Creek South Home Owners Association. Implementation of these guidelines should help to insure that these facilities will continue to operate in the manner which they were designed as defined by the final approved plans of record on file at the Spokane County Division of Engineering and Roads.

The proper operation and maintenance of the stormwater facilities shall include insuring that the stormwater facilities are maintained in such a manner that the established construction specifications, approved plan configuration and design performance standards are maintained at a level that is at least equal to that which the design engineer approved for this project.

II. Description

The stormwater facilities installed with this project consist of three primary systems. The first system includes catch basins, conveyance pipes, curb inlets, and a treatment and detention pond and outlet structure. The second system includes a drainage ditch, ditch inlet, catch basin, manholes, conveyance pipes, and a treatment and detention pond with an outlet structure. The third system simply consists of a detention pond that does not release any water.

The first system collects and controls the stormwater runoff from the newly constructed public roads. The second system collects and controls stormwater runoff from the natural grade slopes to the south of the project site and from the west portion of 11th Court. The third system collects and detains stormwater generated from off-site areas located south of Crescent Drive.

A. Catch Basin, Manholes and Conveyance Pipes

In the first system, catch basins are provided at the low ends of 12th Court, Crescent Drive, 11th Court, and at the low point in 11th Avenue. Stormwater is collected by these catch basins and transported through the piping system, which consists of a combination of 12", 14", and 18" pipes and is comprised of two types of pipe (HDPE and DI). Stormwater is transported by this system to treatment and detention pond "F".

The second system provides a catch basin at the low point of the west portion of 11th. Court. The catch basin drains into the 15" conveyance pipe that transports stormwater runoff collected at the ditch inlet from the natural grade hillside on the south side of the project, to the treatment and detention pond provided between the project site and the south side of Saltese Creek. Manholes are provided as angle points along the conveyance pipe as required.

B. Treatment and Detention Ponds with Outlet Structure

Treatment of the stormwater is required in accordance with the Spokane County Aquifer Sensitive Area Ordinance. The treatment ponds are also utilized as detention ponds. Design methodology was based on minimizing the land area needed to store runoff volumes and using outlet structures to meter the flow to meet Spokane County requirements. A combination of these parameters resulted in the ponds that were constructed for this project.

III. Function

The stormwater facilities for Turtle Creek South, Second and Third Additions are generally very simple and should operate with very little attention. In most instances, a non-functioning system will be visually obvious and regular maintenance of the system will eliminate the occurrence of drainage problems. The following describes each component of the stormwater systems and the proper function of that component in the system.

A. Curb Inlet

The curb inlet provides an inlet to the catch basins and piping system for stormwater collected by the public road gutter system.

B. Catch Basin, Conveyance Pipes, and Manholes

The catch basin is provided to collect runoff from the road areas. The conveyance pipes are provided to route the runoff to the treatment and detention facility. The outlet pipe from the conveyance system has an erosion control feature (riprap) to protect the pond bottom. The manholes are provided for angle points in the piping system.

C. Treatment and Detention Pond with Outlet Structure

The treatment and detention pond accepts runoff from the conveyance pipes for treatment in accordance with the Aquifer Sensitive Area Ordinance and stores the flow until the outlet structure can meter the rate of stormwater outflow for disposal. The outlet area from the conveyance pipe, which is the inlet area to the pond, has been protected from erosion with the installation of riprap. The outlet structure located in the pond has been installed slightly above the pond bottom to allow for treatment of the stormwater, which will also help protect it from siltation. An exception to this is the 18" conveyance pipe

that enters Pond "F" at the pond bottom elevation. Normal operation of the pond will include some ponding, however runoff will be discharged by the outlet structures and disposed of by means of sheet flow down natural grade slopes.

Storage pond "E" is located south side of lots # 3,5,and 6 block 2 of Turtle Creek South 2ND Addition. This pond only collects off-site runoff south of the pond location. This pond has been designed to detain stormwater, so no outlet has been provided.

Treatment pond "F" is located along the north side of lots 1 through 6, block 4 of Turtle Creek South, Second Addition and lot 1, block 1 of Turtle Creek South, Third Addition. The runoff from the public road gutter system enters the pond through the system of catch basins and piping. Runoff exiting the treatment and detention pond flows into a system of four 12" culverts that transfer water under the maintenance road and into a 1-foot deep ditch graded level along the berm side. This ditch is designed to convert flow from point discharge to sheet discharge into Saltese Creek.

Treatment and detention pond "G" is located along the north side of lots 8 and 9, block 1 of Turtle Creek South, Third Addition. The catch basin collects runoff from the west portion of 11th Court. The conveyance pipes collect and control stormwater runoff from the natural grade hillside ditch on the south side of Turtle Creek South, Third Addition enters the pond through a 15" pipe. The pipe from the conveyance system has an erosion control feature (riprap) to protect the bottom of the pond. Runoff exiting the treatment and detention pond flows into Saltese Creek through a weir on the north side of the pond. The manholes serve as angle points for the piping system.

IV. Responsibility to Maintain

Turtle Creek South Home Owners Association will be responsible for the proper operation and maintenance of the stormwater facilities described in this manual. Those systems include catch basins, inlets, conveyance pipes, the treatment and detention pond and the outlet structure. Turtle Creek South Home Owners Association shall follow the methods described in this manual.

V. Maintenance

The following information provides a maintenance description for each of the stormwater elements included in this project. Turtle Creek South Home Owners Association is responsible to provide the maintenance described on the schedule noted within each element.

A. General

The following stormwater facilities shall be visually inspected following a significant rainfall or snowmelt event.

1. Inspect all catch basins, pipe inlets and pond outlet structures making sure that they are clear of debris and obstructions.

B. Curb Inlet

Curb inlets must be maintained free of debris and vegetation to ensure proper stormwater flow to the treatment and detention pond.

C. Catch Basins and Manholes including the Outlet Control Structure

The catch basins and manholes should have the grates removed at least twice a year, once in the spring (April) and once in the fall (October) to insure that they are free from dirt and silt and to insure that they are operating properly. Should excessive silt or dirt be discovered in any catch basin or manhole, it must be cleaned out by means of a vacuum truck.

D. Treatment and Detention Pond

Periodic maintenance of the pond should be done to insure it is functioning properly. The following items should be noted:

1. The rip rap pads, located at the pipe outflow area, should be secure in the areas defined by the plans and should be free from debris. The edges of the rip rap pads should be checked for scouring of the dirt around the pad. Any scouring or gouging of the dirt needs to be repaired and sodded or seeded to insure proper vegetative growth.
2. The bottom of the pond needs to be free from debris and sediment deposition.
3. The outlet pipe needs to be located slightly above the pond bottom elevation to safeguard against siltation. Any siltation building up near the pipe should be removed and the area should be reseeded. Any debris or weeds plugging the pipe needs to be removed.
4. The treatment and detention pond shall be seeded with the following dryland seed mix:

10% Elka Perennial Rye
20% Durar Hard Fescue
45% Covar Sheep / Fescue
15% Reubens Canadian Bluegrass

Provide mixture composed of grass seed and fertilizer in percentages as follows:

Grass Seed: 90 lbs. per acre
Fertilizer: 16-16-16 timed release
Composition, 300 lbs. per acre.

E. High Density Polyethylene Pipe (HDPE) & Ductile Iron Pipe (DI)

The HDPE and DI pipes should be checked periodically for obstructions at each end and twice a year the pipe should be visually inspected to insure that there is not mid-pipe blockage. Should a mid-pipe blockage be observed, it should be removed immediately. In the event that any of the pipes were to fail by being crushed, they must be replaced with the same type and size pipe as soon as the failure is discovered.

VI. Summary

By understanding the stormwater system as described herein and properly maintaining the components, the homeowners of Turtle Creek South, Second and Third Additions will have a long lasting and effective stormwater facility.



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CALCULATIONS FOR ANNUAL OPERATIONS AND MAINTENANCE COST AND REPLACEMENT COSTS PER LOT

ANNUAL OPERATION & MAINTENANCE COSTS	(O&M) =	\$400
PRESENT VALUE OF DRAINAGE SYSTEM	(PV) =	\$38,000
ASSUME 50% REPLACEMENT IN 20 YEARS	(PV/2) =	\$19,000
FV = PV/2 (F/P, 4%, n=20) *		
FV = 19,000 (2.1911)	(FV) =	\$41,630
ANNUAL SET ASIDE FOR FUTURE REPLACEMENT (ASSUME) CONSERVATIVE INVESTMENT = 6%		
A = FV (A/F, 6%, n=20) *		
A = 41,630 (0.0272)	(A) =	\$1,132
TOTAL ANNUAL CHARGE = (O&M) + (A)		
= 400 + 1132	=	\$1,532
ANNUAL CHARGE PER LOT = (TAC) / (#LOTS)		
= 1532 / 65	=	

ANNUAL CHARGE PER LOT = \$23.57

* See attached interest tables.

Factor Table - $i = 4.00\%$

n	P/F	P/A	P/G	F/P	F/A	A/P	A/F	A/G
1	0.9615	0.9615	0.0000	1.0400	1.0000	1.0400	1.0000	0.0000
2	0.9246	1.8861	0.9246	1.0816	2.0400	0.5302	0.4902	0.4902
3	0.8890	2.7751	2.7025	1.1249	3.1216	0.3603	0.3203	0.9739
4	0.8548	3.6299	5.2670	1.1699	4.2465	0.2755	0.2355	1.4510
5	0.8219	4.4518	8.5547	1.2167	5.4163	0.2246	0.1846	1.9216
6	0.7903	5.2421	12.5062	1.2653	6.6330	0.1908	0.1508	2.3857
7	0.7599	6.0021	17.0657	1.3159	7.8983	0.1666	0.1266	2.8433
8	0.7307	6.7327	22.1806	1.3686	9.2142	0.1485	0.1085	3.2944
9	0.7026	7.4353	27.8013	1.4233	10.5828	0.1345	0.0945	3.7391
10	0.6756	8.1109	33.8814	1.4802	12.0061	0.1233	0.0833	4.1773
11	0.6496	8.7605	40.3772	1.5395	13.4864	0.1141	0.0741	4.6090
12	0.6246	9.3851	47.2477	1.6010	15.0258	0.1066	0.0666	5.0343
13	0.6006	9.9856	54.4544	1.6651	16.6268	0.1001	0.0601	5.4533
14	0.5775	10.5631	61.9618	1.7317	18.2919	0.0947	0.0547	5.8659
15	0.5553	11.1184	69.7355	1.8009	20.0236	0.0899	0.0499	6.2721
16	0.5339	11.6523	77.7441	1.8730	21.8245	0.0858	0.0458	6.6720
17	0.5134	12.1657	85.9581	1.9479	23.6975	0.0822	0.0422	7.0656
18	0.4936	12.6593	94.3498	2.0258	25.6454	0.0790	0.0390	7.4530
19	0.4746	13.1339	102.8933	2.1068	27.6712	0.0761	0.0361	7.8342
20	0.4564	13.5903	111.5647	2.1911	29.7781	0.0736	0.0336	8.2091
21	0.4388	14.0292	120.3414	2.2788	31.9692	0.0713	0.0313	8.5779
22	0.4220	14.4511	129.2024	2.3699	34.2480	0.0692	0.0292	8.9407
23	0.4057	14.8568	138.1254	2.4647	36.6179	0.0673	0.0273	9.2973
24	0.3901	15.2470	147.1012	2.5633	39.0826	0.0656	0.0256	9.6479
25	0.3751	15.6221	156.1040	2.6658	41.6459	0.0640	0.0240	9.9925
30	0.3083	17.2920	201.0618	3.2434	56.0849	0.0578	0.0178	11.6274
40	0.2083	19.7928	286.5303	4.8010	95.0255	0.0505	0.0105	14.4765
50	0.1407	21.4822	361.1638	7.1067	152.6671	0.0466	0.0066	16.8122
60	0.0951	22.6235	422.9966	10.5196	237.9907	0.0442	0.0042	18.6972
100	0.0198	24.5050	563.1249	50.5049	1,237.6237	0.0408	0.0008	22.9800

Factor Table - $i = 6.00\%$

n	P/F	P/A	P/G	F/P	F/A	A/P	A/F	A/G
1	0.9434	0.9434	0.0000	1.0600	1.0000	1.0600	1.0000	0.0000
2	0.8900	1.8334	0.8900	1.1236	2.0600	0.5454	0.4854	0.4854
3	0.8396	2.6730	2.5692	1.1910	3.1836	0.3741	0.3141	0.9512
4	0.7921	3.4651	4.9455	1.2625	4.3746	0.2886	0.2286	1.4272
5	0.7473	4.2124	7.9345	1.3382	5.6371	0.2374	0.1774	1.8336
6	0.7050	4.9173	11.4594	1.4185	6.9753	0.2034	0.1434	2.3304
7	0.6651	5.5824	15.4497	1.5036	8.3938	0.1791	0.1191	2.7676
8	0.6274	6.2098	19.8416	1.5938	9.8975	0.1610	0.1010	3.1952
9	0.5919	6.8017	24.5768	1.6895	11.4913	0.1470	0.0870	3.6133
10	0.5584	7.3601	29.6023	1.7908	13.1808	0.1359	0.0759	4.0220
11	0.5268	7.8869	34.8702	1.8983	14.9716	0.1268	0.0668	4.4213
12	0.4970	8.3838	40.3369	2.0122	16.8699	0.1193	0.0593	4.8113
13	0.4688	8.8527	45.9629	2.1329	18.8821	0.1130	0.0530	5.1920
14	0.4423	9.2950	51.7128	2.2609	21.0151	0.1076	0.0476	5.5635
15	0.4173	9.7122	57.5546	2.3966	23.2760	0.1030	0.0430	5.9260
16	0.3936	10.1059	63.4592	2.5404	25.6725	0.0990	0.0390	6.2794
17	0.3714	10.4773	69.4011	2.6928	28.2129	0.0954	0.0354	6.6240
18	0.3505	10.8276	75.3569	2.8543	30.9057	0.0924	0.0324	6.9597
19	0.3305	11.1581	81.3062	3.0256	33.7600	0.0896	0.0296	7.2867
20	0.3118	11.4699	87.2304	3.2071	36.7856	0.0872	0.0272	7.6051
21	0.2942	11.7641	93.1136	3.3996	39.9927	0.0850	0.0250	7.9151
22	0.2775	12.0416	98.9412	3.6035	43.3923	0.0830	0.0230	8.2166
23	0.2618	12.3034	104.7007	3.8197	46.9958	0.0813	0.0213	8.5099
24	0.2470	12.5504	110.3812	4.0489	50.8156	0.0797	0.0197	8.7951
25	0.2330	12.7834	115.9732	4.2919	54.8645	0.0782	0.0182	9.0722
30	0.1741	13.7648	142.3568	5.7435	79.0582	0.0726	0.0126	10.3422
40	0.0972	15.0463	185.9568	10.2857	154.7620	0.0665	0.0065	12.3590
50	0.0543	15.7619	217.4574	18.4202	290.3359	0.0634	0.0034	13.7964
60	0.0303	16.1614	239.0428	32.9877	533.1282	0.0619	0.0019	14.7909
100	0.0029	16.6175	272.0471	339.3021	5,638.3681	0.0602	0.0002	16.3711