

6.0 ALTERNATIVE SOLUTIONS AND RECOMMENDED PROGRAM

This section presents the alternatives evaluated and the recommended stormwater facility improvements for the City. Also provided is a schedule for making the improvements and estimated costs of the improvements. Cost estimates are in 2008 dollars and include design costs, administration, total construction costs, and tax.

6.1 PROPOSED SOLUTIONS TO EXISTING DRAINAGE PROBLEMS

Proposed solutions to the existing drainage problem areas described in Sections 3 and 4 are described below. The improvement projects are numbered, summarized below, and shown on Figure 3-1. The numbered projects (1 through 20) are not prioritized; see Section 6.2 for project prioritization.

1. **Second Street – Park Avenue to Melson Alley.** The storm drain system in Second Street collects runoff from Melson Alley east to Anthes Avenue. The area west of the alley does not have an existing storm drainage system. Connection to the existing catch basin at the alley will alleviate ponding on Second Street. A 12-inch storm drain extending west from the alley is proposed in lieu of a ditch, since the existing shoulder is often used for parking.
2. **Sixth Street East of Anthes Avenue to Brookhaven Creek.** There currently is no conveyance system along this section of Sixth Street. It is proposed that a 12-inch storm drain be constructed on the south side of the street with laterals connecting the north side that would drain towards Brookhaven Creek and connect to the existing culvert. This would help prevent runoff from entering the Creekside Condo's driveway and ponding on Sixth. The addition of a thickened edge along the north side would also direct runoff to the proposed catch basins.
3. **Parking Area at the Bottom of Wharf Street.** The 6-inch storm drain that is broken and causing damage to the pavement will need to be replaced with a 12-inch drain. The City's standards call for a minimum storm drain size of 12-inches (see Section 4.1).
4. **Northview Subdivision Drainage and Detention Pond.** The detention pond's outfall structure needs to be improved by modifying the outlet structure with a riser with an orifice, in place of the existing 12-inch outlet. The orifice should be sized for the pre-developed 2-, and 10-year, 24-hour peak storm events with an overflow at the 100-year design level. The pond may need to be cleaned out by removing sediment that has accumulated at the bottom of the pond. The existing 15-inch outfall to the south will need to be re-routed to the east side of the existing residences and flow into the detention pond as originally designed.

5. **Melson Alley (4th to 6th).** Currently the drainage from Fourth Street is conveyed in an existing ditch along the south side of Fourth Street. The ditch is shallow and ends at the alley just east of Park Avenue. The proposed improvements are to install a 12-inch storm drain system on the south side of Fourth from the existing manhole at Anthes west to Park Avenue.
6. **Intersection of Anthes Avenue and First Street.** The existing catch basin and grates on Anthes Avenue clog easily. Since that is the low spot in the downtown area and the leaves and litter tend to frequently clog the grates, a maintenance routine should be put in place to keep runoff flowing through the system and eliminate ponding. An improvement including upgrading the existing catch basins to Type I structures is recommended to improve operation and minimize maintenance is recommended.
7. **Edgecliff Drive West of Furman Avenue.** There is no drainage conveyance system on Edgecliff Drive west of Furman Avenue. Just west of the intersection with Decker Avenue, ponding occurs on the south side of Edgecliff Drive during storms and extends at times half way across the road. As the residential area south of Edgecliff Drive develops and road improvements are made, a drainage system will be needed. It is feasible for drainage to be conveyed within grass-lined ditches to Noble Creek. The installation of a combination of ditches and 12- to 18-inch diameter driveway culverts draining towards Noble Creek and discharging to the creek either directly or by installing a manhole over the existing culvert is recommended. The quantity of flow through the ditches would be minimal with the implementation of infiltration systems (LID) for new development upstream. The north side of Edgecliff will need an asphalt thickened edge to direct flow to catch basin laterals that outfall into the ditch on the south side.
8. **Furman Avenue.** Furman Avenue does not have a storm drain system and currently sheet flows to Edgecliff Drive causing ponding at the intersection. Along with Decker Avenue a 12-inch storm drain system will be located on the west side with catch basins and laterals on the east directing flow to the storm drainage system along Edgecliff Drive.
9. **Decker Avenue.** Decker Avenue is similar to Furman Avenue as it has no existing storm drainage system and drains to Edgecliff Drive, causing ponding. Along with Furman Avenue a 12-inch storm drain system will be located on the west side with laterals on the east discharging to the Edgecliff Drive drainage system.
10. **Second Street to Cascade Avenue to the Extension of Third Street.** The existing storm drain in Second Street currently ends about halfway up the street to Cascade Avenue. The proposed 12-inch storm drain system will connect to the existing storm drain and extend east to Cascade Avenue. It will then continue on the west side of Cascade to the approximate extension of Third Street. The north and east sides of the streets will be collected with catch basin and laterals connected to the new storm drain.

11. **Sixth Street from Anthes Avenue to Park Avenue.** Currently flow from the ditch along the south side of Sixth Street outfalls into the storm drain system in Melson Alley. This 6-inch pipe is undersized and rerouting the flow with a proposed ditch and 12-inch storm drain system to the existing storm drain in Park Avenue would alleviate the capacity issue. The proposed system will include regrading of the existing ditch on the south side of Sixth Street to drain towards Park Avenue. The proposed 12-inch storm drain system will be extended south from the existing pipe at Fourth Street. The north and east sides of the streets will be collected with catch basins and laterals connecting to the new drainage system. The quantity of flow through the system could be controlled by implementation of infiltration systems through LID practices for new developments upstream.
12. **First Street and DeBruyn Avenue.** Currently there is no street drainage on First Street from DeBruyn to Park Avenue. A proposed 12-inch storm drain system will be constructed on the south side of First Street and outfall into the existing system in Park Avenue. The north side of the street will be collected and routed to the storm drain system by catch basins and laterals.
13. **Second Street and DeBruyn Avenue.** Currently there is no street drainage on Second Street from DeBruyn to Park Avenue. A proposed 12-inch storm drain system will be constructed on the south side of Second Street and outfall into the existing system in Park Avenue. The north side of the street will be collected and routed to the storm drain system by catch basins and laterals.
14. **Saratoga Creek Crossing at Saratoga Road.** Model results indicated that the existing 24-inch culvert is undersized and a 30-inch CMP is needed to convey future 25- and 100-year storm events. The existing pavement is cracking and will need pavement removal and repaving. Monitoring the culvert and pavement during and after storm events and semi-annually is proposed at this time. The monitoring should include keeping a record of pavement condition (including location and dimensions of cracks), water surface elevations, culvert sedimentation build-up, debris at the inlet and outlet, and noting erosion occurring around the culvert inlet and outlet.
15. **Saratoga Creek Crossing at Brooks Hill Road.** There are three existing 12-inch culverts crossing Brooks Hill Road. There have been times when the upstream water level has been observed to be close to the top of the roadway; however the road has not overtopped. The three 12-inch CMP culverts could be upsized to three 15-inch diameter concrete culverts; or to minimize disturbance during construction, one 12-inch culvert could be replaced with a 24-inch CMP. For the time being, monitoring the culverts during and after storm events and semi-annually is recommended. Monitoring should include keeping a record of water elevations, culvert sedimentation build-up, debris at the inlet and outlet, and noting erosion occurring around the culvert inlet and outlet.

16. **Sixth Street west of Park Avenue.** The existing asphalt driveway and South Piney Knoll Lane on the south side of Sixth Street needs repair and has areas of ponding. This will be corrected by regrading the ditch and installing the storm drain system for Project Number 11.
17. **County Outfall System.** The existing ditch along the south side of Edgecliff Drive drains towards the east of the wetlands area discharges into a 24-inch outfall, which was installed by Island County. This ditch is currently overgrown and in need of maintenance. Regrading and cleaning out the existing ditch will improve drainage to the outfall pipe. Existing driveway culverts that are smaller than 12-inches are recommended for upgrade to at least the minimum size. This will be included with the proposed improvements to Edgecliff Drive (Project No. 18). The outfall should be monitored through field observation during and after storm events and semi-annually. Monitoring should include keeping a record of water levels, culvert sedimentation build-up, debris at the inlet and outlet, and noting erosion occurring around the culvert inlet and outlet.
18. **Edgecliff Drive East of Furman Avenue to City Limits.** Ponding occurs at several points along Edgecliff Drive. Installation of proposed ditches and regrading existing ditches to allow runoff to be directed to the County outfall pipe is recommended. Driveway culverts, 12-inch minimum, will be installed at each driveway to allow flow to continue east. The drainage on the north side of Edgecliff will include the installation of an asphalt thickened edge. The thickened edge will direct flow to catch basins with laterals that will outfall into the ditch on the south side of the road. In order to help control surface water run-on from the upstream basin with future development, strict runoff control requirements are recommended.
19. **Brookhaven Creek from Fourth to Third Streets.** Brookhaven Creek recently underwent channel restoration which included several new plantings along the stream banks. The plantings are now all overgrown with weeds and tall grass, the flow is slowed by the weeds and causing ponding and stagnant water. The creek is on private property and needs to have regular maintenance by the property owners to keep the creek flowing as it should.
20. **Water Quality Treatment for Existing Outfalls.** Water quality systems, similar to the existing Contech CDS unit, are recommended for installation at four existing outfall pipes that collect runoff from Pollution Generating Impervious Surfaces (PGIS). It is recommended that the furthest downstream manhole/catch basin prior to outfalling into Saratoga Passage be removed and replaced with a water quality treatment system similar to the Contech CDS unit.

6.2 PRIORITIZATION OF RECOMMENDED IMPROVEMENTS

A summary of problem areas, recommended improvements, and estimated construction costs for each numbered project are presented in Table 6-1. The City prioritization of each project is also presented in this table. Support documentation for cost estimates is presented in Appendix D.

**Table 6-1
Proposed Drainage Improvements**

Project	Priority	Location	Proposed Improvement	Problem	Length / Quantity	Estimated Cost
1	8	Second Street – Park Avenue to Melson Alley	12-inch storm drain	No existing drainage system. Erosion and flooding along the south shoulder of the street during storms.	565	\$110,000.00
2	1	Sixth Street East of Anthes Avenue to Brookhaven Creek	12-inch storm drain	No street drainage, runoff from street flows down driveway of Creekside Terrace Condos.	950	\$190,000.00
3	11	Wharf Street	12-inch storm drain and water quality treatment unit	Break in existing 6-inch storm drain and seepage causing pavement deterioration. No water quality treatment at this outfall.	225	\$60,000.00
4	3	Northview Subdivision Drainage and Detention Pond	Install riser with orifice, re-route existing 15-inch outfall to detention pond with a new 15-inch storm drain	Pond is not providing detention storage, resulting in unregulated flow downstream. A portion of the subdivision area that was designed to drain to the detention pond is flowing directly to Brookhaven Creek.	395	\$70,000.00
5	10	Melson Alley (4 th to 6 th)	12-inch storm drain	Insufficient drainage facilities on Fourth Street causes flooding and erosion near the intersection with Fourth Street.	665	\$130,000.00
6	6	Intersection of Anthes Avenue and First Street	Replace four existing catch basins with Type I structures	Catch basin grates clog easily and have inadequate sediment traps.	4 catch basins	\$20,000.00
7	4	Edgecliff Drive west of Furman Avenue	Ditch and 12- to 18-inch culverts/storm drains	No street drainage on Edgecliff Drive west of Furman Avenue results in ponding near Decker Avenue.	1340	\$280,000.00
8/9	5	Furman Avenue and Decker Avenue	12-inch storm drain	No street drainage on Furman or Decker Avenues results in ponding at the intersections with Edgecliff Drive.	2540	\$490,000.00
10	2	Second Street to Cascade Avenue to the Extension of Third Street	12-inch storm drain	Existing storm drain in Second Street ends halfway up the street towards Cascade Avenue. Cascade Avenue between Second and the extension of Third Streets has no drainage system.	890	\$180,000.00
11	7	Sixth Street from Anthes Avenue to Park Avenue	12-inch storm drain	Sub-standard drainage system and ponding occurs.	880	\$190,000.00

**Table 6-1 (Continued)
Proposed Drainage Improvements**

Project	Priority	Location	Proposed Improvement	Problem	Length / Quantity	Estimated Cost
12	12	First Street and DeBruyn Avenue	12-inch storm drain	No street drainage on First Street from DeBruyn to Park Avenues.	700	\$130,000.00
13	13	Second Street and DeBruyn Avenue	12-inch storm drain	No street drainage on Second Street from DeBruyn to Park Avenues.	730	\$150,000.00
14	Monitor/ Observe	Saratoga Creek Crossing at Saratoga Road	Monitor culvert capacity and pavement condition through field observation	Pipe capacity needs to be evaluated, erosion of the creek has been observed, and roadway pavement has longitudinal cracking.	n/a	n/a
15	Monitor/ Observe	Saratoga Creek Crossing at Brooks Hill Road	Monitor culvert capacity through field observation	Water level upstream of the road has been close to overtopping road during storms. Capacity of three existing 12-inch culverts needs to be evaluated.	n/a	n/a
16	7	Sixth Street west of Park Avenue	Include with Project No.11	Localized ponding along south side of Sixth Street.	n/a	See Project 11
17	Monitor/ Observe	County Outfall System	Monitor culvert capacity through field observation	Existing ditch along south side of Edgecliff Drive drains east and discharges to a 24-inch outfall. The ditch is overgrown and may be causing conveyance issues.	n/a	n/a
18	14	Edgecliff Drive East of Furman Avenue to City Limits	Install new and maintain existing ditches, use 12-inch minimum driveway culverts	Ponding on roadway, bluff erosion, wetland protection, and poor drainage in ditches that need maintenance, areas with no drainage system.	1375	\$120,000.00
19	Maintain	Brookhaven Creek from Fourth Street to Third Street	Maintenance of stream bank plantings by property owner(s)	Slow flow and ponding within creek caused by weeds overgrowing recent stream bank plantings.	n/a	n/a
20	9	Water Quality Treatment at existing outfalls	Replace existing manholes with water quality treatment unit inside new manhole.	Four existing outfalls (Park, Anthes (2), Camano Avenues) have no water quality treatment prior to discharge.	4 units at existing outfalls	\$200,000.00

6.3 IMPLEMENTATION SCHEDULE

The six-year stormwater improvement plan projects are listed in order of priority from 1 to 10 as presented in Table 6-2. Table 6-3 presents the 20-year (or long-term) CIP plan.

Several areas have been identified as potential problems that should be monitored through field observation over time to determine the severity of the problem. Projects to be monitored through observation are presented in Table 6-4. Monitoring will be conducted semi-annually and during and after a storm event. Records will be kept that document the date of observation, water surface elevation, culvert sedimentation build-up, debris at the culvert inlet and outlet, dimensions of erosion present, amount of recorded precipitation, pavement condition, and recent or required maintenance.

One project has been identified as requiring maintenance, which is **Brookhaven Creek from Fourth to Third Streets**. Brookhaven Creek recently underwent channel restoration and new plantings were installed along the stream bank. The plantings are now overgrown with weeds and tall grass. Flow within the creek is slowed by the weeds and causing ponding and stagnant water. The stream banks along the creek channel needs to have regular maintenance to control weeds. As this project is on private property, this work should be completed by the property owner(s).

**Table 6-2
Recommended Improvements – 6-Year Plan**

Project	Priority	Location	Proposed Improvement	Problem	Length / Quantity	Estimated Cost
2	1	Sixth Street East of Anthes Avenue to Brookhaven Creek	12-inch storm drain	No street drainage, runoff from street flows down driveway of Creekside Terrace Condos.	950	\$190,000.00
10	2	Second Street to Cascade Avenue to the Extension of Third Street	12-inch storm drain	Existing storm drain in Second Street ends halfway up the street towards Cascade Avenue. Cascade Avenue between Second and the extension of Third Streets has no drainage system.	890	\$180,000.00
4	3	Northview Subdivision Drainage and Detention Pond	Install riser with orifice, re-route existing 15-inch outfall to detention pond with a new 15-inch storm drain	Pond is not providing detention storage, resulting in unregulated flow downstream. A portion of the subdivision area that was designed to drain to the detention pond is flowing directly to Brookhaven Creek.	395	\$70,000.00
7	4	Edgecliff Drive West of Furman Avenue	Ditch and 12- to 18-inch culverts/storm drains	No street drainage on Edgecliff Drive west of Furman Avenue results in ponding near Decker Avenue.	1340	\$280,000.00
8/9	5	Furman Avenue and Decker Avenue	12-inch storm drain	No street drainage on Furman or Decker Avenues results in ponding at the intersections with Edgecliff Drive.	2540	\$490,000.00
6	6	Intersection of Anthes Avenue and First Street	Replace four existing catch basins with Type I structures	Catch basin grates clog easily and have inadequate sediment traps.	4 catch basins	\$20,000.00
11	7	Sixth Street from Anthes Avenue to Park Avenue	12-inch storm drain	Sub-standard drainage system and ponding occurs.	880	\$190,000.00
1	8	Second Street – Park Avenue to Melson Alley	12-inch storm drain	No existing drainage system. Erosion and flooding along the south shoulder of the street during storms.	565	\$110,000.00
20	9	Water Quality Treatment at existing outfalls	Replace existing manholes with water quality treatment unit inside new manhole.	Four existing outfalls (Park, Anthes (2), Camano Avenues) have no water quality treatment prior to discharge.	4 units at existing outfalls	\$200,000.00
5	10	Melson Alley (4 th to 6 th)	12-inch storm drain	Insufficient drainage facilities on Fourth Street causes flooding and erosion near the intersection with Fourth Street.	665	\$130,000.00

**Table 6-3
Recommended Improvements – 20-Year Plan**

Project	Priority	Location	Proposed Improvement	Problem	Length / Quantity	Estimated Cost
3	11	Wharf Street	12-inch storm drain and water quality treatment unit	Break in existing 6-inch storm drain and seepage causing pavement deterioration. No water quality treatment at this outfall.	225	\$60,000.00
12	12	First Street and DeBruyn Avenue	12-inch storm drain	No street drainage on First Street from DeBruyn to Park Avenues.	700	\$130,000.00
13	13	Second Street and DeBruyn Avenue	12-inch storm drain	No street drainage on Second Street from DeBruyn to Park Avenues.	730	\$150,000.00
18	14	Edgecliff Drive East of Furman Avenue to City Limits	Install new and maintain existing ditches, use 12-inch minimum driveway culverts	Ponding on roadway, bluff erosion, wetland protection, and poor drainage in ditches that need maintenance, areas with no drainage system.	1375	\$120,000.00

**Table 6-4
Recommended Improvements – Maintenance and Monitoring**

Project	Action	Location	Proposed Improvement	Problem
14	Monitor/ Observe*	Saratoga Creek Crossing at Saratoga Road	Monitor culvert capacity and pavement condition through field observation	Pipe capacity needs to be evaluated, erosion of the creek has been observed, and roadway pavement has longitudinal cracking.
15	Monitor/ Observe*	Saratoga Creek Crossing at Brooks Hill Road	Monitor culvert capacity through field observation	Water level upstream of the road has been close to overtopping road during storms. Capacity of three existing 12-inch culverts needs to be evaluated.
17	Monitor/ Observe*	County Outfall System	Monitor culvert capacity through field observation	Existing ditch along south side of Edgecliff Drive drains east and discharges to a 24-inch outfall. The ditch is overgrown and may be causing conveyance issues.
19	Maintain	Brookhaven Creek from Fourth Street to Third Street	Maintenance of stream bank plantings by property owner(s)	Slow flow and ponding within creek caused by weeds overgrowing recent stream bank plantings.

* Monitoring through field observation to be conducted semi-annually and during and after a storm event. Records will be kept showing the date of monitoring, water elevation, culvert sedimentation build-up, debris at inlet and outlet, erosion, amount of recorded precipitation, and recent or required maintenance.