Inventory and Channel Assessment Report

For

Springfield Waterways

Pierce Channel
Reach Plot

Q St Floodway
Concrete Control Structure

August 2004

Environmental Services, Water Resources

Acknowledgements
This report was prepared by the Water Resources section of the Environmental Services Division of Springfield Public Works by Sunny Washburn.

The Project Overview-Summary includes information provided by the “Summary of Internship Activities” prepared by Shawn Krueger and David Irons, interns with the City of Springfield on the channel assessment 2002 project.

Site-specific assessment reports and maps were prepared by Sunny Washburn; City of Springfield / Environmental Services, Water Resources Section.

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Introduction and Background

This report is an assessment of the condition of the City's open channel stormwater drainage system. Data in the report categorizes, describes, and summarizes the physical characteristics of the various systems throughout the City, in terms of the channel configuration, the adjacent land uses, and certain water quality parameters. To this end, it represents a 'snapshot' of the City's drainage system at the time of the survey (summer, 2002) as viewed through several qualifiers, and seeks to present this large amount of data in a usable and informative format.

The assessment includes basic water quality data, surrounding land use, observed plant and animal species, and measured channel configuration data at plot locations. Knowing channel configuration will enable City staff to refine the water storage potential of the channels, and so determine discharge and flow rates. Other information will assist with land use planning, state and federal water quality permitting and compliance, and provide important information to the City's Engineering, Maintenance and Planning staff, with regard to the overall condition and capacity of the City's open drainage system. It serves as an inventory of baseline information to assist with development of the City's Storm Water Management Plan Program and the associated Stormwater Management Plan, and important background information to assist with Springfield's Stormwater Facilities Master Plan. It's in this capacity that this report becomes an active and integrated part of the City's stormwater management program. Finally, it provides a significant amount of 'real time' information for staff regarding channel condition and capacity, riparian health, invasive species, and water quality in the City's open drainage system.

Regulatory Context

This assessment is situated in, and contributes to, a complex regulatory landscape. Specifically, the assessment was designed to address the following 'data gaps' within the City system:

- Collects baseline information on channel configuration and capacity for future stormwater modeling efforts and maintenance activities, and identifies potential point sources of pollution.
- Gathers baseline information on existing water quality, riparian vegetation, and bank damage from invasive plant and animal species.
- Using a defined scoring system, evaluates the overall health of the water quality system and riparian areas.
- Gathers information on and provides for mapping in-channel structures such as staff or stadia gauges, weirs, culverts, abutments, and drop structures.
- Identifies project opportunities to enhance the system, stabilize channel and riparian zones or initiate neighborhood education projects.
- Identifies native plant seed collection sites for City riparian restoration projects.

Springfield is affected by several state and federal regulations which make this assessment especially relevant. The Federal **National Pollutant Discharge Elimination System** (NPDES) permit program is a provision of the Federal Clean Water Act (CWA), and regulates stormwater discharges to waters of the State. Implementation of this program has been delegated to the States. The Oregon Department of Environmental Quality is responsible for implementation in Oregon.

Under this program, the City of Springfield is a 'Phase II' Municipal Separate Storm Sewer System (MS4) community. As an NPDES MS4 permittee, the City is subject to requirements regarding how it manages stormwater runoff, both water quantity and quality. This assessment was conducted, in part, to assist with meeting the long-range requirements of this program. The result, the data presented in this report will support the City's CWA-NPDES Storm Water Management Program Plan.

Another provision of the CWA is the requirement that the State develops and implement a **Total Maximum Daily Load** (TMDL) for certain waterways. Provisions of the TMDL program limit the amount of specified pollutants that may be discharged to a listed waterway. In Springfield's case, both the Willamette and McKenzie rivers are listed as 'Water Quality Limited' waterways, and are receiving waters for stormwater runoff from the City of Springfield. While the state's TMDL program is still under development, both of these waterways will receive TMDLs, with the McKenzie being listed for temperature, and the Willamette being listed for both temperature and mercury.

Other programs which benefit from this assessment include the City's response to the Endangered Species Act (ESA), and the Safe Drinking Water Act (SDWA).

The federal **Endangered Species Act** (ESA) provides protection for threatened and endangered plant and animal species. The City of Springfield has a considerable concern regarding the presence of endangered Spring Run Chinook Salmon in the receiving waters of the City's stormwater runoff, primarily in the McKenzie River.

These concerns are two-fold: first, pollutants in contaminated stormwater runoff may present a direct hazard to the health of migrating salmon. Secondly, work practices within the city, both by City crews or developers and contractors, may create adverse conditions in side channels and tributaries affecting spawning and rearing activities by the fish. These 'adverse' conditions consist primarily of erosion from construction sites and sedimentation into spawning and rearing areas of the tributaries. A third concern spanning these two, is creating an adverse temperature regime within the tributaries, which would directly impact spawning, rearing, and migrating populations, both in tributaries and within the main channel of the river.

This assessment identifies factors which may pose a concern for endangered salmonids, including temperature concerns, impediments to migration, and channel/bed conditions. Further, it recommends capital projects intended to remediate identified problems and provides baseline information to assist with assessing any proposed remediation projects.

Springfield relies on groundwater for much of its domestic water supply. The federal **Safe Drinking Water Act** (SDWA) includes provisions for developing wellhead protection plans, including hazardous material storage and handling requirements, mapping and delineation of wellhead-time-of-travel information, and emergency response program development.

Since surface water can influence ground water wells, including long-term contamination of underground aquifers, this assessment included water quality screening and a brief overview of the riparian health and adjacent land uses, which can be useful for wellhead protection planning. Additional information collected by the assessment team included the presence of invasive species, a determination of the dominant plant communities, and the identification, mapping, and seed collection sites of native and threatened riparian plant communities.

Use of this Document

This report presents the project data, and includes a summary of the survey methodologies and protocols. It represents an extensive field effort by City staff, and development of a significant database of information which is summarized in the report. Supporting this information, and not included in the report, is a field manual and data collection forms which were developed especially for this project, and provide detailed inspection and assessment procedures and protocols. The digital database of the survey data is also available. Methods and protocols followed in this field survey are primarily a synthesis of other accepted survey protocols utilized by other agencies and jurisdictions, tailored to more closely fill the needs of the City.

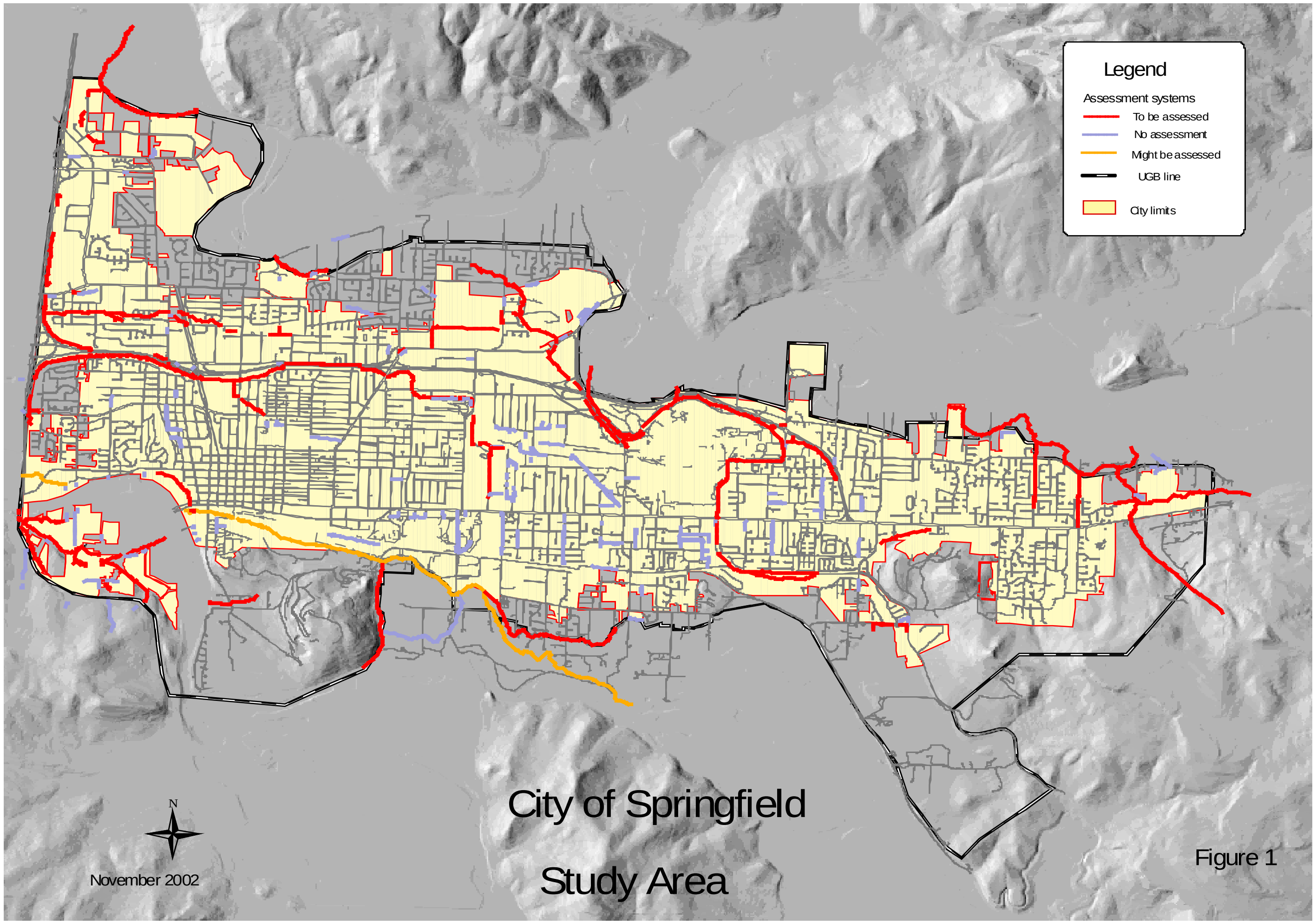
The intention of this study is to be an 'iterative' document, with a capability of seamlessly including new or better data as it is developed. Further, the databases summarized in its development are retained, so data is 'searchable' as new data is included or unidentified needs arise. In this way, the Inventory will stay current, and the Assessment portion becomes a useful tool to track and document the effectiveness of improvement projects, new policies, and growth over time.

This document will be updated periodically, both to include new or refined data and to track the evolution of the present sites, their plant communities, channel condition, and water quality. The original digital databases will be preserved on the City's computer system, both for easy updating and to allow for future searches of the database for other as-yet-unidentified purposes. If you have any questions concerning this data or the assessment or survey methodologies, please contact the Environmental Services Division of the Springfield Public Works Department.

Overview-Summary

Scope

In June 2002, the Water Resources section of the Environmental Services Division for the City conducted a city-wide inventory and assessment of all surface drainage stream and channel systems that discharge to the Willamette and McKenzie Rivers. At the time of this assessment 44 stream systems within the Urban Growth Boundary (UGB) had been identified for the assessment study area. See figure 1, study map.



Methodology

The channel assessment methods were synthesized from several existing assessment protocols, and were enhanced to gather specific information on channel configuration and condition, as well as information from the adjacent riparian areas. Most definitions, protocols and indicators came from the *USDA - Stream Visual Assessment Protocol* and *Clean Water Services (CWS) - Rapid Stream Assessment*. Other sources used were: *The Summary of Current Status and Health of Oregon's Riparian Areas* by Professor Stan Gregory; Oregon State University, the *Oregon Department of Fish and Wildlife (ODFW); The Streamkeeper's Field Guide*, and the *Natural Resources Conservation Service (NRCS) Stream-A-Syst guide.*

The synthesized methodology was reviewed, 'field proofed' to insure its ability to be easily implemented in the field, and assembled into handbook form. Field sheets were developed to record the information in the field. The handbook listed specific objective criteria to be used in assessing and recording relevant information for each section of the field assessment form. The assessment handbook is on file at the City of Springfield Environmental Services Division (ESD).

Data defining the *system/reach structure*, *water/bank profile*, and *riparian profile* was gathered on a reach-by-reach basis. Each system was inspected in the field, using the standardized assessment technique and scoring methodology. Several aspects of each survey site (plot) were subjectively scored from 1 to10 (see table 3), representing general waterway and riparian area health. An overall health rating was derived from the scoring results. The overall health rating results returned a condition or functional value of poor, fair, good or excellent for the system. This subjective scoring was always based on the consensus of at least two trained observers. While several trained assessors were involved in the study, at least one highly experienced assessor was participating at all times.

All assessment information was recorded on a reach-by-reach basis, with one field data sheet generated for each reach plot. Plots were selected based on the site being representative of the reach. Each system was given a unique identifying name and reach number. A Global Positioning System (GPS) device was used in addition to field maps for recording longitude and latitude of each reach plot, any in-channel structures, or other significant points within the reach. Once the assessment was completed, each site was flagged using surveyors tape with the reach ID, location, and date written on the tape. A digital photo was taken at each assessment plot site. All data was later entered into a database.

Scoring / Rating Methodology

A stream is a complex ecosystem in which several biological, physical, and chemical processes interact. Changes in any one characteristic or process have cascading affects throughout the system (see figure 2). Due to the complexity and changing nature of these variables not all influences in the chart could be investigated. However, this scoring and rating methodology attempts to record the most critical elements of a stream system.

Riparian areas provide critical ecological functions and high biological diversity because they contain components of both terrestrial and aquatic ecosystems. As interfaces between land and water, riparian areas are important for both terrestrial and aquatic biota. Streamside corridors strongly influence water quality, including stream temperature, nutrient loading, sedimentation, and contaminants from terrestrial sources. Food webs in stream ecosystems depend on terrestrial vegetation as source of food (such as leaves, needles, wood) and habitat structure (such as large wood, pool formation, bank stabilization). Birds, mammals, amphibians and other terrestrial animals depend on riparian areas for a variety of habitat, cover, and food sources in close proximity to water *(Gregory, 2000).*

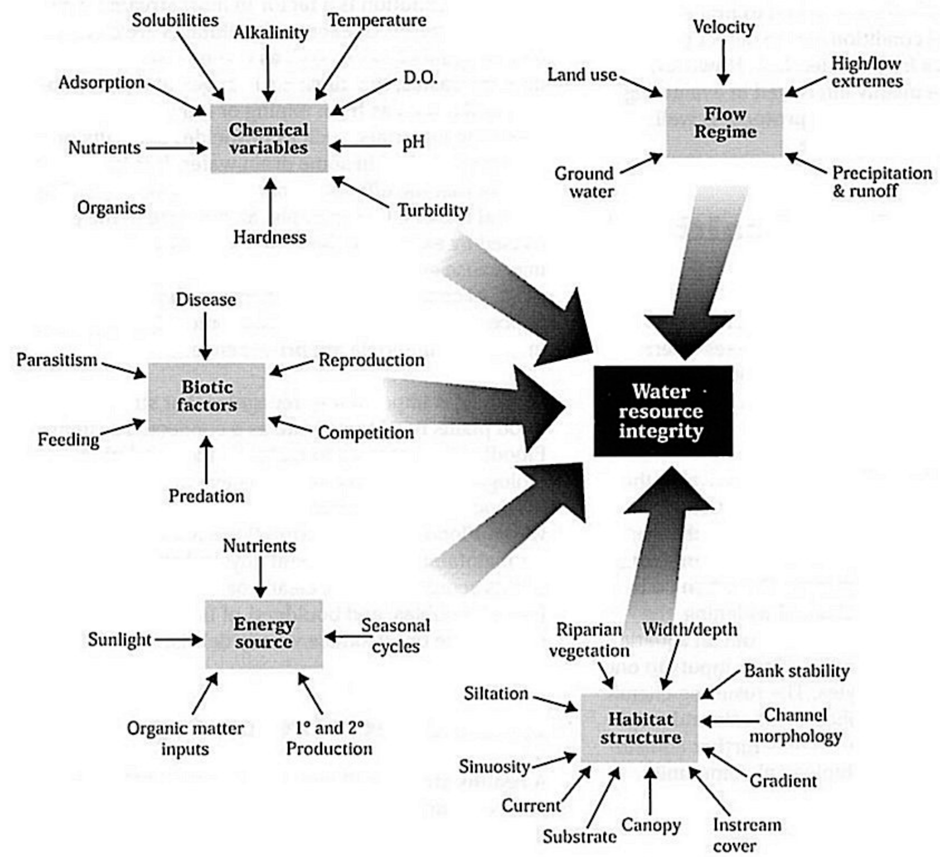


Figure 2 Factors that influence the integrity of streams (modified from Karr 1986)

The eight general scoring categories that were rated in the assessment, with '1' being poor, to '10' being excellent are:

- Channel condition
- Water appearance
- Nutrient enrichment
- Bank stability
- Canopy density/cover
- Invasive damage by plants
- Invasive damage by animals/amphibians
- Manure/Waste presence (waste consisting of human feces or transient camps)

Three additional categories were used for systems designated as Salmonid Bearing Waters (SBW) by the state or listed as Water Quality Limited Watercourses (WQLW) by the City.

- Barriers to fish passage
- Insect/Invertebrate habitat
- In-stream fish cover

(See table 4 for set scoring criteria)

In general, the scoring range of poor (1) described the reach as follows: heavily channelized, down-cut channels with very turbid or visually polluted water, pea green or severe algae blooms, unstable banks with sloughing, <20% of the surface shaded in the reach, extensive damage from invasive plants choking the waterway or overrunning the riparian area, extensive damage from invasive animals burrowing the banks, extensive amounts of manure or human waste on bank or in the system. If an SBW or WQLW then poor (1) included; drops or weirs >1 foot in the reach, 0 to 1 type of insect habitat, and 0 to 1 type of in-stream fish cover.

The scoring range of excellent (10) described the reach as: a natural channel or altered <50% with no downcutting, very clear water, diverse aquatic plant community, stable banks, >75% of the surface water shaded, invasive plants <10%, invasive animal damage <10%, no evidence of livestock or transient camping activity in the riparian area. If an SBW or WQLW, then excellent (10) included: no drop structures or weirs, at least 5 types if insect habitat, and >7 types of in-stream fish cover.

The scoring of each reach was then totaled and divided by the number of categories scored. This returned an overall health rating. The overall heath ratings are based on the functional value of a stream or channel system. Functional values are benefits provided by resources (see figure 2). The ratings return a value that is interpreted as poor (<6.0), fair (6.1 - 7.4), good (7.5 - 8.9), and excellent (>9.0), this numeric value represents the "Functional Value" of the system or reach. The functional value can be used as a general statement about the "state of the environment", or over a period of time as an indicator of "trends" in the conditions, or as a baseline study to characterize health.

$$\frac{\text{Total Score of Categories}}{\text{Number of Categories}} = \text{Functional Value (Health Rating)}$$

Seed collection

The City of Springfield periodically re-vegetates soils disturbed by construction activities or other causes. City restoration projects, such as the Mill Race Ecosystem Restoration Project, and stormwater management facilities, such as detention ponds, require re-vegetation with plant species well-suited to the soils, hydrology and eco-region. Native plant sources are needed to provide seed stock for a wide variety of applications, and a list of suitable native species was developed by ESD staff prior to this project.

The assessment crew was trained in plant identification and seed collection techniques by BLM wetland and native plant specialists. Since this work required working in areas where local native riparian plants were seeding, the flagging, collection, and mapping of native seed and location sites was viewed as an opportunity to efficiently and cost-effectively develop an inventory of seed to be used on public infrastructure and restoration projects.

During the assessment, the assessment team located seed sites, which were flagged and monitored until the seeds were ready for harvest. Each species that was collected required slightly different methods for maximum efficiency. Once collected, the seeds were dried, cleaned, sorted, and stored for future use. There will be an ongoing effort to produce a guidance manual for Springfield's maintenance and landscape crews to use. As well, the seed stock will be made available to the Army Corps of Engineers for use in the Mill Race Ecosystem Restoration Project.

Data Management

All field data collected by the assessment team was entered onto paper 'field forms'. Later, the data was entered into a computer database and spreadsheet program for future reference.

- A Microsoft Access database was set up with an on-screen assessment form for data entry of the assessment data. All data from the field forms were entered into the database.

- An Excel spreadsheet of all seed collection sites was created. The seed collection information included the common and scientific names of the plant, stream system where it was found, reach ID and/or GPS location of the plant(s), and date of seed collection. A Geographical Information System (GIS) data-file showing the seed collection area was also created. This data will be used for future seed collect projects and provide an interface to track these efforts with GIS.

- An Excel spreadsheet index of all photos was created and stored in the project directory along with digital photos of each assessment site. This photographic record will allow for future comparisons of the site, to identify project sites, and provide reference.

Interim Findings/Conclusions

A majority of the open channel systems have been surveyed. However, a channel assessment has not been completed for all waterways at this point. Approximately 8.6 linear miles remain to be assessed, to be completed during the summer of 2004-05. A summary of the data collected during the summer survey of 2002-03 includes the following information:

Outcome of data collected on systems during summer 2002-03:

- 44 systems to be assessed. 33.14 linear miles.
- 38 systems completed containing 210 reaches. 24.54 linear miles.
- 6 Systems not completed totaling 8.6 linear miles:
  - 2 Largest systems: Mill Race, South Cedar Creek. 6.18 linear miles.
  - 3 Difficult Systems: Keizer Slough, Maple Island Slough and Quarry Creek. (Two of the 3 were attempted but incomplete). 2.70 linear miles.
  - 1 will be re-classified as a ditch, not a channel, and will not be assessed.

- Overall health rating for 38 systems: 23 rated poor, 15 rated fair, 0 rated good, 0 rated excellent.
- Average health rating for the city as a whole is **5.8** which is a health rating of **poor**.

Outcome of Seed Collection efforts:

- 12 drainage systems identified for potential seed collection sites.
- 35 sites identified within the 12 systems.
- 29 species identified plus 1 species of Threatened/Endangered/Sensitive (T/E/S).
- 7 varieties of seed collected in varying quantities.
- All seeds collected have been dried, sorted, processed, and safely stored pending use either as seed-stock for further seed propagation or direct use to re-vegetate riparian areas.

Outcome of Photos collected:

- 236 digital photos were taken of plots and in-channel structures.

System and Reach Profile

44 systems within the Urban Growth Boundary (UGB) were identified and chosen for the assessment. Of those systems, 38 were completed, containing 210 individual reaches. Of these reaches, all relevant field data was collected and logged into the database, and all GPS waypoints consisting of plots and in-channel structures were converted to a GIS data-file.

Using visual observation, the dominant land use within the 200 foot buffer on each side of the stream was determined. In cases of multiple uses, the most prevalent usage was recorded. Residential use was the most common land use followed by Undeveloped, Commercial, Agricultural, Transportation Corridor, Public/Park, Utility Corridor and Industrial.

Human-made impingements (for this project: structures that impinge, infringe, or encroach upon) have a high potential for interrupting or modifying the hydrology of a channel. Impingements occurring in the active channel, within the bank or immediately adjacent to top of bank were mapped, recorded, and in some cases photographed. These structures were categorized into three classifications: Fully impinged (>60% of bank length of a reach effected), partly impinged (40% or less), and non-impinged.

Fully impinged systems were most often observed. The most common impingements, in order of occurrence, are: fences, asphalt roads/parking lots, gravel road/drive/lot, house/shed/building, sidewalks, guard rails, bike paths, concrete walls and railroad tracks. Partially impinged systems were second most common, consisting of: fences, asphalt roads/parking lots, mobile homes/houses/building, gravel roads/drive/lots, sidewalks, bike paths, guardrails, and rock walls. Non-impinged reaches were the least encountered. Overall, fences, asphalt roads, and parking lots are the most-frequently encountered structures. Most systems have some full to partially impingements.

Water Quality/Bank Profile

During the assessment, basic water quality parameters were measured and recorded. Documenting water temperature and pH (acidity or alkalinity) is useful to discover potential sources of industrial pollution or other illicit waste dumping into streams and waterways, as well as 'profiling' the temperature regimen of the stream as it moves through the City's system. The date and time, as well as ambient air temperature were also recorded to determine if a correlation exists between time of day, date, and any observed variations in the temperature or pH. Date and time of day will also provide a useful reference for future assessments. Only flowing waterways were sampled; isolated or stagnant pools of water were not sampled.

The table 1 below shows the pH and water temperature ranges and averages for the systems:

Survey dates: May 30th, 2002 through August 29th, 2002 and June 2nd, 2003 through December 12th, 1003
Air Temp: 14.3°C to 39.1°C (57.7°F to 102.4°F) 13.4°C to 34.9°C (56°F to 94.8°F)

Table 1 – Water Quality Summary Data

<table>
<tr><th>Water pH</th><th>Water Temperature</th><th>Temperature for Salmonids</th></tr>
<tr><td>16 systems dry</td><td>16 systems dry</td><td rowspan="8">Optimal: 13°C to 20°C
(55.4°F to 68°F)

Lethal: >25° C (>77°F)
TMDL
Standard: 17.8°C (64°F)

14 systems averaged optimal
0 systems averaged lethal
4 systems averaged marginal</td></tr>
<tr><td>1 system stagnant</td><td>1 system stagnant</td></tr>
<tr><td>3 systems dry & stagnant</td><td>3 systems dry & stagnant</td></tr>
<tr><td></td><td></td></tr>
<tr><td>18 systems averaged: 7.26</td><td>18 systems averaged: 19°C (66.2°F)</td></tr>
<tr><td>average minimum: 6.83</td><td>average minimum: 16.7°C (62.7°F)</td></tr>
<tr><td>average maximum : 7.76</td><td>average maximum: 21.9°C (71.4°F)</td></tr>
<tr><td>Range: 5.4 to 9.6</td><td>Range: 12.6° C to 42.1°C (54.7°F to 107.8°F)</td></tr>
<tr><td>DEQ stormwater standard
pH range 6.0 to 9.0</td><td></td><td></td></tr>
</table>

Water temperatures were lowest along natural systems with significant channel flows and gradient that was heavily shaded by overhanging trees and vegetation. The highest temperatures were found along channels with low gradient, shallow depths, were heavily channelized and had little or no overhanging vegetation.

At the time of each assessment, the water flow level within each reach was estimated relative to the active channel. This is a measurement of the depth of the water during the assessment compared to the 'normal' flow in that part of the channel. This information is useful when used with date, time and air temperature to determine how representative the observations are, relative to the usual or normal water level. During the summertime assessment, which was conducted during a relatively dry year, most systems were flowing at less than ¼ to ½ of the active channel. Two systems were at full active channel width and 16 systems were dry.

Normal, healthy waterways exhibit limited nutrient loading. The presence of organic materials, excess fertilizers, or some types of pollution results in algae growth, which in turn can deplete water of its oxygen content. When this happens, aquatic life in the stream suffers. In this way, the presence of algae can be an indicator of stream health. Water that has high nutrient enrichment may support communities of algae, which provide a greenish color to the water. Streams with heavy loads of nutrients have thick coating of green algae attached to the rocks and other submerged objects. In response to unidentified triggers algae will rise to the surface as mats and die turning brown. The assessment looked at how frequently algae were observed in the channel, the quantities present, and what color of algae was observed. Most systems ranged from 'none present' to 'moderately abundant'. The most common color of algae recorded was brown/green and brown. Brown floating mats were common on the Q St Floodway, an indicator of high nutrient loading and the algae floating to the surface and dieing.

Measuring the physical dimensions, including the bank top and bottom width, depth, and side slope of the banks of the channel provides an indication of the water-storing capability of the channel during high water levels. This cross section information is important when trying to size new contributing outfalls or re-working older infrastructure to accommodate new development. At each reach plot, measurements of the top of bank, active channel, bottom of channel and bank slope were taken. Measurements were recorded in feet and tenths of feet. There were several reaches where it was impractical to get exact measurements for all categories. Some sites required visual estimates due to inaccessible banks. In cases where a bank was inaccessible, the run was calculated by subtracting the known run and bottom of channel from the total top of bank measurement (measured or estimated). The average slope for all banks and all systems is 50.62%. The average range is from 25.28% to 210%. The minimum slope is 4% and the maximum slope is 750%. Normally, steep banks are more prone to erosion and bank sloughing; shallower banks tend to provide more storage of stormwater peak flows. However, each system is different, with different optimal conditions, and there is no one 'optimal' bank slope.

The channel cross-sectional shape, or reach profile was visually estimated and recorded for the entire reach, along with measurements of the bank slope length, channel width, and bank angle to estimate the cross-sectional area of the channel. This information is useful for stormwater flow modeling and channel capacity calculations. In addition to determining channel capacity, knowing the general channel shape serves as an indicator of erosive channelization and down-cutting. Three primary streambed configurations were observed during the assessment. Most systems start out in their upper reaches as a U-shaped channel and end up downstream as a U-shaped channel. However, some systems start out V-shaped and end ponded, while other systems start out ponded and end V-shaped. This indicates that most of the systems are low-gradient systems that are channelized, and are shaped by cleaning with equipment. Two systems have sections of rectangular reaches consisting of a poured concrete channel. There is also one system with one reach that has a U-shaped poured concrete channel; all three are not subject to erosion or natural shaping processes.

Bedload refers to the silt, rocks, and other strata that make up the actual bottom of the stream. Bedload material analysis can aid in determining if channel scouring, bank instability, high sediment load from stormwater runoff, or degradation of in-stream habitat is occurring. Stream bedload material from the channel bottom to a depth of less than 6" was evaluated, and a determination made, of whether the streambed was alluvial (silt or deposited material) or bedrock, siltstone, or other geological formation. For most of the systems, the bed-load material consists of a silt, sand, and clay mixture. Several cobble and gravel reaches were observed, and three reaches were concrete lined.

In-channel structures, like impingements may alter the stream's hydrology. Any man-made structure found inside the top of bank was mapped, and in some cases digitally located and recorded using the GPS. Several forms of weirs and drop structures (all designed to modify hydrology) were encountered. Photos were taken of different styles of weirs and drop structures, and are currently stored digitally for later reference.

Riparian Profile

Riparian vegetation is a critical element of stream health. A healthy riparian area provides water filtering functions for runoff as well as shade for cooling and covers for wildlife. Broadly categorizing the riparian areas in the survey helps identify problematic areas for future remediation, as well as identifying high-value areas for preservation or enhancement.

Eight plant community definitions were used in defining the riparian plant community. For this evaluation, a narrow riparian buffer of ten feet (10') each side of, and inclusive of, the drainage system channel was used. Knowing the makeup of the plant community will assist City maintenance crews with carrying out maintenance work, and in planning where trees might be planted, erosion mitigated, or native plant communities developed. Further, it identifies sites which may be targeted for mitigation of invasive species, and provides a baseline 'snapshot' of the riparian area to track future changes in the riparian area.

Most of the reaches are in urban or suburban areas, resulting in the surrounding plant communities that are fragmented. Only the most prevalent community was listed. Most systems consisted of a "grass/field" plant community. The next most prevalent community was a "Hardwood" community. "Dominated by invasive" was the third largest and was used where virtually the entire plant community was overgrown with invasive and ornamental species.

The City conducts ongoing actions against invasive plant and animal species. By locating and documenting the presence of invasive species, the survey data can guide future control programs. The staff that performed the survey was trained prior to field deployment in plant identification of 21 invasive species and field identification of invasive animal species, mainly nutria and bullfrogs. The invasive species were recorded as being ‘Dominant’, ‘Co-dominant’, ‘Present’, and ‘Others’. This system was used to identify invasive that are most prominent from those that are starting to appear.

From the list of 21 species, 16 showed up repeatedly as ‘Dominant’, ‘Co-dominant’ or ‘Present’. 5 species showed up under the ‘Other’ category. The most common invasive species recorded in all three categories was *Rubus armeniacus* (Armenian Blackberry). Armenian Blackberry and *Phalaris arundinacea* (Reed Canary-grass) formed large monocultures which choke out the active channels as well as any other plant life. *Festuca arundinacea* (Tall Fescue) was included on the list of invasive species, however, the difficulty in identifying this species from other fescues in the field made it difficult to adequately assess its impact. See table 2 below for the top ten invasive species, <u>in order</u>:

Table 2 - Leading Invasive Species

Dominant	Co-dominant	Present	Others
Armenian Blackberry	Armenian Blackberry	Armenian Blackberry	Ornamentals
Reed Canary grass	Reed Canary grass	Velvet grass	Butterfly Bush
Velvet grass	Nightshade	Teasel	Knotweed
Tall Fescue	Teasel	Reed Canary grass	Poison Hemlock
Nightshade	English Ivy	Nightshade	Vinca Major (periwinkle)
English Ivy	Velvet grass	Morning Glory	
Evergreen Blackberry	Morning Glory	English Ivy	
Morning Glory	Yellow Flag Iris	Penny Royal	
Yellow Flag Iris	Broom	Broom	
St John’s Wort	Harding grass	Evergreen Blackberry	

The project had a list of 22 native riparian/wetland species targeted for seed collection. 7 species were collected, 33 sites were mapped on 10 systems and 1 non-waterway. When these species were observed, the actual plant was flagged, a GPS waypoint was recorded and the location was mapped.

Given the highly disturbed nature of most of the streamside environments, potential for locating Threatened, Endangered and Sensitive (T/E/S) species of plants was limited. However, a rare Sidalcea species (Mallow) along the I-105-55th St Channel was recorded and mapped. Efforts will continue to be made to acquire more information on T/E/S species and their locations.

Invasive animal species cause thousands of dollars of damage to City infrastructure through burrowing, feeding, and property destruction. Identifying and locating high concentrations of these species is the first step toward eliminating them. The most regularly encountered invasive animals were Nutria (a South American rodent related to muskrats). Beaver, although native, were viewed as an invasive in the context of urban drainageways, due to the damage they can cause to vegetation and hydrology. Bullfrogs were the most common invasive amphibian. Due to the number and wide spread habitation of these three pests, no special mapping was done, but their presence was noted. The most commonly encountered forms of damage were from Nutria, primarily from heavily tunneled, undercut and vegetation-stripped banks. Live and dead Nutria were encountered daily, which was both an aesthetic and water quality (bacterial contamination) concern. The most heavily damaged banks were found along the lower reaches of the Q St. Floodway, the I-5 Gateway Channel and portions of Channel 6. Two fairly large Beaver dams were found on the I-5 Gateway Channel just west of Don St.

Any unusual bird populations observed in the area during the assessment were noted. Most of the species observed were, to some degree, dependent on riparian habitat or stream health. Great Blue and Green herons were encountered in several reaches, as were Belted Kingfishers, and Common Yellowthroats. Mallard ducks (adults and ducklings) were found regularly. Pacific Green Tree frogs, small minnows, fish and tadpoles (unidentified to species) were found in many systems. Raccoons were seen twice. Commonly encountered wildlife evidence included feces, burrowing, nests, dens, trails and tracks.

4 types of riparian or stream restoration project opportunities were identified. The most frequently recorded was riparian buffer enhancements (with 'no' to 'very little' native riparian vegetation in most reaches). Next was neighborhood education (to eliminate dumping of yard debris and properly manage herbicide use), bank stabilization, and then culvert retrofit/replacement.

Scoring and Overall Health Rating

Averages for the waterways are listed below. Criteria averages were derived by adding each criteria score together and dividing it by the number of times it was scored. Overall health rating averages were derived by adding each health rating for each system together then dividing it by the number of waterways.

The average score and averaged overall health rating for the total number of systems assessed revealed the following:

Table 3 – Averaged Overall Channel Health Scores and Rating

Scored Criteria	Criteria Averages on a Scale of 1 to 10
Channel Condition	3.1
Water Appearance	6.5
Nutrient Enrichment	5.5
Bank Stability	6.8
Canopy Density/Cover	4.0
Invasive Damage – P	3.8
Invasive Damage – A/A	9.4
Waste Presence	8.0
Barriers to Fish (SBW)	7.5
Insect/Invert Habitat (SBW)	6.1
In-stream Fish Cover (SBW)	3.7

Average Overall Health Rating
5.79

Health Rating Scale
<6.0 = Poor
6.1 – 7.4 = Fair
7.5 – 8.9 = Good
>9.0 = Excellent

The Overall Health Rating for **all the systems averaged together is 5.79, which is a (functional value) health rating of POOR.** Refer to scoring methodology section for description and process.

The scoring averages reveal that channel condition, canopy density/cover, and invasive damage from plants rated lower than average. On SBW or WQLW; channel condition, canopy density/cover, invasive damage from plants, and in-stream fish coverall rated lower than average (refer to table 3).

Actions

Urban streams are subject to a wide range of impacts, from physical barriers, habitat loss and adverse water quality influences. This reach assessment broadly focuses on overall stream conditions and riparian health, using a number of assessment parameters, in an effort to identify high-value restoration areas and projects. However, opportunities for project implementation are moving targets, with shifting priorities as the community develops, priorities change, and unforeseen opportunities present themselves. For that reason, the recommendations outlined in the section should be considered a starting point, and not a completed project list. This assessment also looked at only one part of a "Unified Stream Assessment" (a Reach Assessment) therefore it is difficult to pinpoint precise restoration or project opportunities. Implementing some or all of the 1 to 3 year suggestions as well as performing "Impact Assessments" as suggested in the 3 to 5 year suggestions, is a starting point for urban watershed restoration development and pollution point source elimination.

Impact Assessments collect information at individual problem sites along a stream corridor. There are eight types of impact assessments:

1. Outfalls
2. Severe erosion
3. Impacted buffers
4. Utilities in the corridor
5. Trash and debris
6. Stream Crossing
7. Channels modifications
8. Miscellaneous or unusual features

Even though this assessment did evaluate certain elements of an impact assessment, performing complete impact assessments will allow for identifying exact actions to be taken on reach-by-reach bases.

Reach Assessments look at a stream channel on a section-by-section basis, and determine an average condition for the bank stability, in-stream habitat, riparian vegetation, connectivity, access, and flow over an entire reach.

As a result of this study, we now know more precisely where Springfield's main waterway systems flow, the condition of the channels and the associated riparian areas, and the uses of the land surrounding them. Detailed mapping is being performed in GIS format to provide connectivity with the piped systems, benchmarks are established for water quality and for vegetation, and some "hot spots" have been identified for future investigation.

The following sections outline both short- and long-term suggested actions for implementation, as well as recommendations for future impact assessments.

Suggestions for immediate actions (1 to 3 years)

A waterway with an overall heath rating of "Poor" can be improved by looking at the below-average scored criteria and applying some immediate actions. The following suggestions will improve the overall health of low-scoring reaches:

- Channel Condition - overall average score: 3.1
  - Implement an "Impact Assessment" for Channel Modifications using Use the *Center for Watershed Protection's Urban Subwatershed Restoration Manual No. 10; Unified Stream Assessment: A User's Manual.* Perform an assessment on channels that rated below average for Channel Conditions. Review rating systems on impact assessments so they don't conflict with channel designs, based on City engineering standards and City erosion issues.
  - Work with Public Works Maintenance crews to broaden their understanding of channel condition and erosion concerns related to maintenance practices.
  - Initiate budget process to implement stream management BMPs and/or restoration measures.

- Canopy Density/Cover - overall average score: 4.0
  - Develop a priority list of channels based on below average scores for canopy density/cover that can be targeted for tree or shrub planting, to provide shade. This list will also identify easement and private property issues in advance to facilitate restoration efforts.

- Re-assess Maintenance Division's practice of herbicide spraying and the cutting or mowing of native trees in riparian areas, with a goal of removing or trimming only what is needed for access and maximizing shade.
- Implement and/or enforce City Code to minimize tree-cutting, and herbicide use in riparian areas by developments and by property owners.
- Implement riparian setbacks from open waterways to promote stream shading vegetation.
- Develop a public awareness program that will better inform the community on stream protection and water quality issues.
- Identify project areas which will work well for volunteer or community-oriented invasive brush clearing, tree planting or native shrub planting events, and work with local groups to advance this idea.

- Invasive Plant Damage – overall average score: 3.8
    - Work with maintenance crews on identifying invasive species. Identify staff that can later develop BMPs for eradication of various common species.
    - Develop a priority list for maintenance crews to use when targeting species for herbicide use and/or hand removal programs. Use the *City of Springfield Invasive Plants List* as a guide.
    - Work with Engineering and Planning departments to develop and implement lists for invasive plant species, Springfield native plants, and Springfield native riparian plants for distribution to homeowners, community groups, and other interested parties. Current lists for wetland planting and pond planting are also in need of updating.
    - Develop educational handouts for the public regarding native and invasive plants, and distribute door to door along waterways and in other appropriate venues.
    - Continue mowing and other maintenance activities. Concentrate more effort on blackberry and English Ivy eradication that can promote native plant growth.

- In-stream Fish Cover (Salmon Bearing Waterways only) - overall average score: 3.7
    - Inform key maintenance personnel as to what SBW and WQLW waterways are and the restrictions surrounding them.
    - Alter mowing and maintenance practices that may remove beneficial woody debris in waterways designated as SBW or WQLW.
    - Identify project areas which will work well for volunteer or community-oriented invasive brush clearing, tree planting or native shrub planting events, and work with local groups to advance this idea.
    - Reassess the Maintenance Division's practice of herbicide spraying and the cutting or mowing of native trees in riparian areas, with a goal of removing or trimming only what is needed for access and maximizing shade.
    - Implement, enhance, and/or enforce City Code to minimize tree-cutting and herbicide use in riparian areas by developments and property owners.
    - Implement and enforce riparian area setbacks from open waterways for new development, where appropriate, to promote stream shading vegetation.
    - Develop a public awareness and outreach program that will identify and better inform the community on stream protection, water quality facilities such as ponds and water quality issues.
    - Coordinate with community groups, stakeholders, other jurisdictions, and citizens to engage them in awareness, outreach, and service programs, with an emphasis on water quality and stewardship.

<u>Suggestions for long-term actions (3 to 5 years)</u>

- Perform another channel assessment to measure progress (or lack of progress) with implementation and track channel and riparian health. Schedule assessments to be performed earlier in the season for systems with no- or low summertime flows, to obtain water quality data.

- Perform Impact Assessments to obtain a complete unified stream assessment. Use the *Center for Watershed Protection's Urban Subwatershed Restoration Manual No. 10;* Unified *Stream Assessment: A User's Manual.*
- Add City owned/maintained detention ponds and any City owned/maintained wetlands, swales, etc. to the assessment process. Develop and implement criteria similar to that developed for the channels. This can be included in an impact assessment or an assessment project by itself that has contributing factors to the channel assessment.
- Continue to perform maintenance activity for invasive species eradication. Use the *City of Springfield Invasive Plants List as a guide*.
- Continue mowing and maintenance activities.
- Coordinate with ODF&W and City Maintenance to develop a priority list and plan to provide woody debris to systems designated as SBW or WQLW where appropriate.
- Budget, prioritize, and implement a plan for large woody debris introduction.

Future Assessments

Methodology and approach

- Evaluate *the City of Springfield's Channel Assessment Manual* and update as needed.
- Incorporate "Impact Assessments" into the assessment process.
- Locate as close to same reach plot location as that used in the previous Channel Assessment.
- Conduct additional water quality sampling during the assessment when a low pH, chemical smell, or other indicators of unusual water quality are observed.
- Incorporate ponds, swales and other existing natural stormwater filtering systems into the assessment process.
- Use precision GPS equipment for gathering point information that will be incorporated into GIS data sets. GIS datasets needs to meet survey and GIS standards.
- Acquire missing flow and/or elevation data that will aid in stormwater modeling for Stormwater Facilities Master Plan (SWFMP). Needs to meet survey and GIS standards.

Schedule

- Target March as a starting month for in-stream assessment work to be able to incorporate more water quality parameters.
- Use the *Center for Watershed Protection's Urban Subwatershed Restoration Manual No. 10;* Unified *Stream Assessment: A User's Manual* for guidance on timelines for performing impact assessments.

Appendices

Site-specific inventory information

Site-specific information for waterways included in this survey is available for review as separate reports, and are included as appendices to this report. See the table of contents for a list of systems assessed and their appendix number. The following information is reported for each system that was assessed, and classified by reach.

Each system report (Appendix) addresses:

- ***Overview*** (site location and waterway information).
- ***Findings / Conclusions*** (site-specific findings and conclusions).
- ***Actions*** (site-specific suggestions for immediate and long-term actions).
- ***Maps and GIS information*** (site maps, major drainage basins, impervious surface).

Table 4 - Set Scoring and Rating Criteria

Channel condition

Natural channel; no structures, dikes. No evidence of down-cutting or excessive lateral cutting. **Only used for Natural System.**	Natural channel; evidence of past channel alteration, but with significant recovery of channel & banks. **Only used for Natural System.**	Altered channel; <50% of the reach with riprap and/or channelization. Excess aggradations or downcutting occurring. Dikes or levees at or close to channel.	Channel is actively downcutting or widening. >50% of the reach with riprap or channelization. Dikes or levees define the channel.
10	7	3	1

Water appearance

Very clear, or clear but tea-colored; objects visible at 100% or to the bottom. (90%-99% if slightly colored); no oil sheen on surface; no noticeable film on submerged objects or rocks.	Some cloudiness, objects visible at ¾ or 75% of the depth; may have slightly green color; no oil sheen on water surface.	Considerable cloudiness most of the time; objects visible to ½ or 50% of the depth; slow sections may appear pea-green; bottom rocks or submerged objects covered with heavy green or olive-green film.	Very turbid or muddy Appearance; objects visible to < ¼ or 25% of the depth; slow moving water may be bright-green; other obvious water pollutants; floating algal mats, surface scum, sheen or heavy coat of foam on surface. or Strong odor of chemicals, oil, sewage, other pollutants.
10	7	3	1

Nutrient enrichment

Clear water along entire reach; diverse aquatic plant community. Includes low quantities of many species of macrophytes; little algal growth present.	Fairly clear or slightly greenish water along entire reach; somewhat diverse aquatic plant community moderate algal growth on system substrates.	Greenish water along entire reach; overabundance of lush green macrophytes; abundant algal growth, especially during warmer months.	Pea green, gray, or brown water along entire reach; dense stands of macrophytes clogging system; severe algal blooms creating thick algal mats in system.
10	7	3	1

Bank stability

Banks are stable. No erosion, bare banks, rills, gullies, or sloughing.	Moderately stable; some erosion or sloughing starting to occur. May have some rills starting.	Unstable banks; straight reaches and inside edges of bends are actively eroding as well as outside bends. Bare bank. Numerous mature trees falling into system. Numerous slope failures apparent.
10	5	1

Canopy Density/Cover

> 75% of water surface shaded in the reach. Dense	50% to 75% of water surface shaded in the reach. Sparse	20% to 50% of water surface shaded in the reach. Open	< 20% of water surface shaded in the reach. None
10	7	3	1

Table 4 - Set Scoring and Rating Criteria - Continued

Invasive damage by plant species

Very little damage- <10%. Not forming monocultures, not over running riparian area or under-story, not choking the waterway or trees/shrubs. Native species present.	Some damage 10% to 25%.	Moderate damage >25% - 50%	Extensive damage >50%. Forming large monocultures or over running riparian area and or under-story. Choking of the waterway and or trees/shrubs – no native species present.
10	7	3	1

Invasive damage by animal/amphibian species

Very little damage: <10%. No burrows or bank tunneling, no damaged trees or shrubs, no damming or dens in waterway. No bank failure and/or erosion. No Large loss of vegetation – from feeding and/or erosion.	Some damage 10% to 25%.	Moderate damage >25% - 50%	Extensive damage: >50%. Burrows or bank tunneling, damaged trees or shrubs, damming or dens in waterway. Causing bank failure and/or erosion. Large loss of vegetation – from feeding and/or erosion.
10	7	3	1

Manure/Waste presence

No Evidence of livestock access into riparian zone. and/or Evidence of homeless camp, or transient activity in riparian zone.	Evidence of livestock access into riparian zone. and/or Evidence of homeless camp, or transient activity in riparian zone.	Occasional manure or human waste in system. and/or waste storage structure located on the flood plain.	Extensive amount of manure or human waste on banks or in system. and/or Untreated human waste discharge pipes present.
10	5	3	1

Barriers to fish movement

No drop structures, dams, weirs, and/or culverts. or Piped sections	Drop structures, dams, weirs, and/or culverts: < 1 foot drop within the reach. and/or Piped sections under 150’	Drop structures, dams, weirs, and/or culverts: > 1 foot drop within the reach. and/or Piped section over 150’
10	5	1

Insect/invertebrate habitat

At least 5 types of habitat available. Habitat is at a stage to allow full insect colonization (woody debris and logs not freshly fallen).	3 to 4 types of habitat. Some potential habitat exists, such as overhanging trees, which will provide habitat, but have not yet entered the system.	1 to 2 types of habitat. The substrate is often disturbed, covered, or re-moved by high system velocities and scour or by sediment deposition.	0 to 1 type of habitat.
10	7	3	1

In-stream fish cover

>7 cover types available	6 to 7 cover types available	4 to 5 cover types available	2 to 3 cover types available	None to 1 cover type available
10	8	5	3	1

Glossary

Active channel width: The width of the stream at the bankfull discharge. Permanent vegetation generally does not become established in the active channel.

Aggradations: Geologic process by which a stream bottom or flood plain is raised in elevation by the deposition of material.

Bankfull discharge: The stream discharge (flow rate, such as cubic feet per second) that forms and controls the shape and size of the active channel.

Bankfull stage: The stage at which water starts to flow over the flood plain.

Baseflow: The portion of stream flow that is derived from natural storage; average stream discharge during low flow conditions.

Bed load: Refers to the silt, rocks, and other strata that make up the actual bottom of the stream.

Boulders: Large rocks measuring more than 10 inches across.

Channel: A natural or artificial waterway of perceptible extent that periodically or continuously contains moving water. It has a definite bed and banks that serve to confine the water.

Channelization: Straightening of a stream channel to make water move faster.

Cobbles: Medium-sized rocks which measure 2.5 to 10 inches across.

Degradation: Geologic process by which a stream bottom is lowered in elevation due to the net loss of substrate material. Sometimes referred to as downcutting.

Downcutting: See Degradation.

Ecoregion: A geographic area defined by similarity of climate, landform, soil, potential natural vegetation, hydrology, or other ecologically relevant variables.

Emergent plants: Aquatic plants that extend out of the water.

Flood plain: The flat area of land adjacent to a stream that is formed by current flood processes.

Functional Value: The functional value of a stream, returned as a mathematical number referred to as Health Rating. Variables include: flow regime, chemical variables, biotic factors, energy source, and habitat structure.

Gradient: Slope calculated as the amount of vertical rise over horizontal run expressed as ft/ft or as percent.

Gravel: Small rocks measuring 0.25 to 2.5 inches across.

Gully: Runoff cuts rills deeper & wider, several rills come together & form a larger channel called a gully.

Habitat: The area or environment in which an organism lives.

Impingement: Human-made structures that impinge, infringe, or encroach upon and have a potential for interrupting or modifying the hydrology of a channel. Impingements occur in the active channel, within the bank or immediately adjacent to top of bank. Examples include fences, roads, bridge foundations, and/or buildings.

In-channel Structures: Human made structures inside the channel banks and or channel. Used for the purpose of water quality and hydrology. Examples include culverts and drop weirs.

Macrophyte bed: A section of stream covered by a dense mat of aquatic plants. A Macrophyte is a large water plant opposed to small & microscopic plants such as algae.

Meander: A winding section of stream with many bends that is at least 1.2 times longer, following the channel, than its straight-line distance. A single meander generally comprises two complete opposing bends, starting from the relatively straight section of the channel just before the first bend to the relatively straight section just after the second bend.

Macro invertebrate: A spineless animal visible to the naked eye or larger than 0.5 millimeters. Example: an insect.

Nickpoint: The point where a stream is actively eroding (downcutting) to a new base elevation. Nickpoints migrate upstream (through a process called headcutting).

Plot: An area or section within the reach and within the banks of the system that best represents the reach. All information for the reach is gathered based on this area or section.

pH: Parts Hydrogen.

Point bar: A gravel or sand deposit on the inside of a meander; an actively mobile river feature.

Pool: Deeper area of a stream with slow-moving water.

Reach: A section of stream (defined in a variety of ways, such as the section between tributaries or a section with consistent characteristics).

Riffle: A shallow section in a stream where water is breaking over rocks, wood, or other partly submerged debris and producing surface agitation.

Rill: As surface flow changes from sheet flow to deeper concentrated flow along the low spots of the soil surface it creates rivulets. Cutting grooves called rills. Rills are small but well-defined channels that are a few inches deep.

Riparian: The zone adjacent to a stream or any other waterbody (from the Latin word ripa, pertaining to the bank of a river, pond, or lake).

Riprap: Rock material of varying size used to stabilize streambanks and other slopes.

Scouring: The erosive removal of material from the stream bottom and banks.

Stadia Gauge: Also referred to as a staff gauge. An upright, mounted or free standing measuring stick. Used to measure water depth.

Substrate: The mineral or organic material that forms the bed of the stream; the surface on which aquatic organisms live.

System: For this project a system refers to the type of waterway. Examples include creeks, channels, and sloughs.

Top of Bank: For this project will be the point at bankfull stage that the water will breach the bank into the flood plane.

Turbidity: Murkiness or cloudiness of water caused by particles, such as fine sediment (silts, clays) and algae.

Waypoint: Generated by the GPS device. Recorded point in the GPS database by Longitude/Latitude, and name.

Acronym Glossary

CWA Clean water Act

CWS Clean Water Services

DSD Development Services Department (City of Springfield)

ENG Engineering Division (City of Springfield)

ESA Endangered Species Act

ESD Environmental Services Division (City of Springfield)

GIS Geographical Information System

GPS Global Positioning System

NPDES National Polluant Discharge Elimination System

NRCS National Resource Conservation Services

ODFW Oregon Department of Fish and Wildlife

OSU Oregon State University

SDWA Safe Drinking Water Act

SBW Salmonid Bearing Waters

SWMPP Storm Water Management Plan Program

T/E/S Threatened, Endangered, Sensitive species

TMDL Total Maximum Daily Load

UGB Urban Growth Boundary

USDA United State Department of Agriculture

WQLW Water Quality Limited Watercourses (City of Springfield)