CHAPTER 3

BASIS OF PLANNING

The stormwater master planning process used available physical and scientific information, and included a number of assumptions. This chapter describes the information and assumptions that formed the basis of planning for the Corvallis Stormwater Master Plan (SWMP), including the timeframe for the project, level of service provided, engineering standards, modeling parameters, methods for estimating costs, implementation strategies, and related regulations. The basis of planning provides a reference point from which to evaluate the results and recommendations, and for updating the plan in the future.

3.1 TIME FRAME FOR ANALYSIS

In the fall of 1997, the City of Corvallis (City) contracted with Brown and Caldwell to assist in developing the SWMP. The most current information was used to construct the models and perform the analyses.

The City provided mapping (e.g., streets, tax lots, streams, water bodies, and other major features) from its Geographic Information System. Lane County Council of Governments (LCOG) provided information on land use based on 1999 information. LCOG was under contract with the City Planning Department to update land-use maps for the City's *Draft Corvallis Comprehensive Plan* (1998). Photogrammetric coverage with 2-foot contour increments from 1998 was used to define the topography of the study area. Information on the collection system (e.g., pipe diameters, invert elevations, depth of cover, and channel geometry) was provided by the City over the course of the project. City survey crews collected field data as necessary. The consultant team collected other data during stream walks or other field investigations.

3.2 LEVEL OF SERVICE

The City's *Design Criteria Manual for Public Improvements* (July 1991) specifies a "10-year design storm" for sizing storm drains. In general, this pertains to a collection system designed to convey storm flow that is expected to occur approximately once every 10 years. The 10-year design storm was used to size pipes, culverts, and bridges modeled by this planning effort. Other design storms were modeled, including the 2-, 5-, 25-, and 100-year storm events, to determine how the stormwater collection system would react under these different storm conditions.

The 25-year storm event was modeled to identify the required capital improvements should the City choose to use a 25-year design storm in the future, rather than the 10-year storm that is the design basis of the existing system. The costs associated with upsizing the stormwater conveyance system were determined to be excessive compared to maintaining the current 10-year design storm basis. The 100-year event was also modeled to assist in identifying properties that would be impacted by this large storm event.

The 2-year storm was used to evaluate the potential for stream erosion because this size storm is responsible for most sediment transport and channel-forming activity in streams. The channel-forming or dominant discharge is a theoretical discharge that, if maintained in an alluvial stream over a long period of time, would produce the same channel geometry that is produced by the long-term natural hydrograph. Channel-forming discharge is the most commonly used, single independent variable that is found to govern channel shape and form. Channel-forming discharges are found in storm events with 1- to 2.5-year recurrence intervals (USDA, 1998). Studies in King County, Washington, confirmed that the 1- to 2-year flows moved the most sediment over time (Booth, 1997).

The velocity at which channel erosion begins depends on a number of factors including the slope of the channel, steepness of the streambanks, soil characteristics, and the amount and type of stabilizing vegetation. A threshold of 4 feet per second was chosen for stream erosion based on allowable velocities for cohesive soils and/or grass-lined channels (NCSCC, 1988; MDOE, 1998; Smoot and Smith, 1999).

3.3 ENGINEERING STANDARDS

The following engineering standards were used to determine system deficiencies and needed improvements:

- Surcharged pipes were classified as undersized. However, they were not recommended for replacement unless surface flooding had also been observed.

- The installation of a parallel pipe to increase capacity was not considered to be cost-effective due to conflicts with other utilities. Replacement of the undersized pipe with a larger pipe was recommended as the more desirable solution.

- Culverts were considered to be appropriately sized if they could convey the 10-year design storm flows without creating upstream backwater conditions. Culvert replacement or the installation of a parallel culvert was recommended when headwater conditions created by an undersized culvert threatened upstream property or the stability of a roadbed. The recommendation of either a new replacement culvert or a parallel culvert was based on cost and on the physical geometry of the site.

- Existing bridges that passed flows from the 10-year design storm were considered adequately sized. Bridges for Oregon Department of Transportation (ODOT) roads are designed for larger storm events, but the SWMP identifies only the deficiencies associated with the 10-year design storm.

3.4 MODELING PARAMETERS AND ASSUMPTIONS

The product, XP-SWMM (Stormwater Management Model) version 5.2, was selected as the hydrologic and hydraulic model for the project. The model enables the user to perform a detailed examination of flooding, backwater, and velocities within the stream and piped system. XP-SWMM contains a modified version of the U.S. Environmental Protection Agency's SWMM program.

The model was used to predict peak flows, water elevations, and velocities for existing and future development conditions for 2-, 5-, 10-, 25-, and 100-year design storms. The model was used to identify flooding problems, size pipes and culverts, and identify stream reaches susceptible to excessive erosion.

The following subsections describe the design storms used in the modeling process. The subsections include a summary of model calibration efforts and a brief discussion of model assumptions.

3.4.1 Design Storms

The design storm used in the modeling was based on an actual Corvallis rainfall event. The rainfall distribution (incremental volume over time) of the design storm was based on the rainfall pattern from the December 24 to 29, 1998 storm event. During this 5-day period, 5.15 inches of rain fell with 3.64 inches accumulating in the 24-hour period beginning at 1 p.m. on December 27. This 24-hour rainfall volume is approximately equal to the 10-year event predicted by the National Oceanic and Atmospheric Administration (NOAA) Atlas X (1973) commonly used for deriving design storms. The days before and after this event were included in the model to allow the model time to come to equilibrium with the rainfall and soil moisture conditions.

To model other storm events, the rainfall distribution for the 10-year storm was modified by multiplying the incremental volumes by the factors listed in Table 3-1. The storms used in the model included the 2-, 5-, 10-, 25-, and 100-year storms.

Table 3-1. Design Storm Rainfall Multiplier

Return frequency (years)	2	5	10	25	100
Multiplier	0.7	0.8	1.0	1.1	1.3

This approach was used in lieu of a traditional synthetic design storm, such as the SCS Type IA distribution. The U.S. Soil Conservation Service developed this methodology in the mid-1980s (SCS, 1986). Although the SCS Type IA storm has been widely used throughout the Pacific Northwest, the use of a rainfall distribution based on historic rainfall records more closely reflects the type of storm distribution found in the Willamette Valley. In general, the typical Willamette Valley storm distribution does not have the short, steep sloped hyetograph (a graph showing rainfall over a period of time) associated with the SCS Type IA storm. To more closely approximate storm patterns found in Corvallis, the hyetograph for the design storm had more gradual leading and trailing edges. (See Appendix C for more details.)

Peak flows in stormwater systems are highly dependent on the soil conditions present before a storm (antecedent conditions). The peak flow rate generated from a given storm may have a recurrence interval different from that of the rainfall event due to varying soil moisture conditions. Design storms constructed from SCS distributions and 24-hour rainfall volumes tend to create higher peaks than those that are observed in long (25+ year) simulations using actual rainfall records, (Bedient and Huber, 1993). Thus, the true return period for a simulated storm event is uncertain.

Distributions and 24-hour rainfall volumes create higher peaks and lower total volumes than what has been observed in long (40+ year) simulations using actual rainfall records. The SCS distributions do not accurately account for antecedent rainfall by allowing too much of the rainfall to infiltrate at the beginning of the storm.

3.4.2 Model Calibration

The calibration data used for this study was based on water surface elevations measured during the December 24 to 29, 1998 storm and from anecdotal information. The public provided information on storm and flooding events during public meetings and by City engineering and maintenance personnel familiar with the storm collection system. In addition, previous master planning efforts had model results that were compared to the new XP-SWMM models.

Calibration data was available for Dixon and Squaw Creeks. Table 3-2 presents the results of the calibration effort based on surface water elevations from the December 24 to 29, 1998 storm. In general, the model predicted water surface elevations similar to actual observed conditions. The results were consistent with model tolerances based on available channel and calibration data.

Table 3-2. Calibration Results

Location	Measured elevation, feet	Modeled elevation, feet
Dixon Creek		
9th Street bridge	217.8	218.6
Grant Avenue bridge	224.2	225.4
Garfield Avenue bridge	228.3	228.3
Circle Boulevard bridge	240.0	240.2
Squaw Creek		
Knollbrook Place bridge	225.7	225.6
Country Club Place culverts	237.5	237.8

3.4.3 Model Assumptions and Limitations

This modeling effort was primarily aimed at determining system deficiencies related to flooding and flow restrictions resulting from improper channel or pipe size. Modeling of the pre- and post-development peak runoff flows was not meant to be used to quantify the effects of urbanization. Instead, modeling data were developed to determine flow relative to conveyance capacity for the purpose of sizing pipes, culverts, and other structures. To develop conservative recommendations for storm drainage infrastructure, a worst-case scenario was modeled. That scenario assumed that the peak rainfall occurred coincident with high soil saturation and that the storage and infiltration capacity was low for both the pre- and post-development conditions. Thus, most of the precipitation that fell was converted to surface runoff, and this assumption led to pre- and post-development peaks that were relatively close and high in magnitude.

Although this assumption provided a sound approach for determining system deficiencies, it would not be appropriate for a modeling effort aimed at quantifying the differences in pre- and post-development runoff. While the modeled effect of little change in pre- and post-development peaks may be true for rare storms with return periods greater than 5 to 50 years and with high rainfall volumes, it would not be realistic for smaller, more frequent storms under less saturated conditions where a greater proportion of the precipitation that falls would be stored and routed as subsurface flow. A greater difference in development-related runoff response would result compared to that shown in the model. The difference would be more pronounced in the hillslope areas with deeper, loamier soils and greater storage capacities compared to the areas with clayey soils on the valley floor.

The model showed only runoff as surface flow; no subsurface and interflow storage and runoff mechanisms were included. The shift in the dominance of subsurface storage and runoff components in pre-developed conditions to surface runoff dominance in post-development conditions for the greatest percentage of storm events was not represented.

In addition, the modeling was not intended to provide direct water quality information or flow analyses necessary for determining mass loading of water quality components. Additional assumptions regarding modeling are in Appendix C.

3.5 METHODS FOR ESTIMATING COSTS

Project costs vary depending on the specific conditions of the project site. The accuracy of the cost estimate, therefore, depends on the amount of site information available, as discussed below. This information is expanded upon in Appendix D.

Type of Estimate – The costs developed for the SWMP are order-of-magnitude estimates, and not budget estimates or definitive estimates, as defined below.

- **Order-of-Magnitude Estimate** – This type of estimate is approximate, and is made without detailed engineering data. Calculations involving cost-capacity curves, scale-up or scale-down factors, and ratios are used in developing such an estimate. Typically an order-of-magnitude estimate is considered accurate within a range of plus 50 percent or minus 30 percent. That is, the final cost may be as much as 50 percent more or 30 percent less than the estimated amount.

- **Budget Estimate** – This estimate is prepared based on field observations, or using process flow sheets, layouts, and equipment details. A budget estimate is normally accurate within plus 30 percent or minus15 percent.

- **Definitive Estimate** – As the name implies, this is an estimate prepared from well-defined engineering data, such as construction plans and specifications. At a minimum, the data must include fairly comprehensive plot plans and elevations, piping and instrument diagrams, one-line electrical diagrams, equipment data sheets and quotations, structural drawings, soil data and drawings, and a complete set of specifications. The most accurate estimate would be based on construction drawings and specifications. The accuracy of a definitive estimate would fall within plus 15 percent or minus 5 percent.

Cost Index – All costs were updated using the *ENR Construction Cost Index* of 6300, representing costs for June 2000. The costs for acquisition of land or easements were not included for any of the engineered or riparian enhancement alternatives.

Provisions for Engineering, Administration, and Contingencies – Other project costs have been assumed to be equal to 45 percent of the construction costs of the project. This includes 20 percent for engineering, 5 percent for administration, and 20 percent for contingency. The same percentage was assumed for both engineered and restoration projects because, although the restoration projects typically involve less engineering, they require a large permitting effort.

3.6 IMPLEMENTATION STRATEGY

A strategy for implementing improvements was developed for each watershed. The strategy was based on a combination of four categories of activities, including capital projects, maintenance activities, policies, and community involvement. Each category is described below.

- **Capital Projects** – Capital projects include structural solutions to stormwater runoff, such as pipes, bridges, culverts, stream restoration, streambank stabilization, detention ponds, and swales.

- **Maintenance Activities** – City maintenance activities can address a number of flow and water-quality-related problems. The City can provide personnel and equipment for manual and machine-assisted removal of debris and sediment from channels, pipes, and culverts; alter street sweeping and catch basin cleaning activities; and take other measures.

- **Policies** – Upon its adoption, the SWMP, including the policies in Chapter 5, will become an amendment to the City of Corvallis Comprehensive Plan. Selected policies from the SWMP will also be added to appropriate sections of the Comprehensive Plan.

- **Community Involvement** – Community members can be involved in a number of activities that improve stream and riparian habitat conditions, such as educating the community and participating in volunteer activities for restoring or enhancing the watershed. Activities can be implemented by community groups, neighborhood associations, schools, scout troops, and stream associations.

The strategy for each watershed basin was divided into two levels of implementation: Short-Term Program and Long-Term Program. Each level of implementation is described below.

- **Short-Term Program** – Identifies the immediate needs of the stormwater system within each watershed and implements improvements over an approximate 10-year period. Improvements are implemented when funding and resources are available, and generally result in the highest benefit with the least amount of cost.

- **Long-Term Program** – Represents projects to further protect and restore the health of the watershed that would be implemented over a longer time frame, generally upon complete implementation of the Short-Term Program. In some cases, long-term programs may be implemented concurrent with the Short-Term Program, especially when the implementation is staged over a long period of time.

3.7 RELATED REGULATIONS

Several federal and State regulations govern various aspects of local stormwater management activities. These include the National Pollution Discharge Elimination System (NPDES), Total Maximum Daily Load (TMDL), and the Endangered Species Act (ESA). Each regulation addresses a different aspect of stormwater management and must be incorporated into a comprehensive management plan.

3.7.1 National Pollution Discharge Elimination System

The authorizing legislation for municipal stormwater management is the 1987 federal Clean Water Act (CWA) amendments. They provide for municipal discharge permits to be issued on a system-wide basis. Through this legislation, the NPDES requirements were expanded to include the regulation of stormwater discharges. Cities that discharge treated wastewater to a waterway currently operate wastewater treatment facilities under an NPDES discharge permit. Companies that discharge stormwater from industrial sites also receive permits under these requirements. Operation of a municipal separate storm sewer system (MS4) requires an NPDES permit. Agricultural stormwater is not currently managed by NPDES.

National stormwater permitting was initiated by the NPDES Phase I requirements promulgated in 1990. Phase I requirements focused on cities with more than 100,000 people, industrial facilities, and construction sites that disturbed 5 acres or more land. The Phase II requirements published in December 1999 extended the permitting to include "small" cities and construction sites that disturb lands from 1 to 5 acres. Corvallis is included in the Phase II permitting.

Regulations issued to implement the MS4 permitting system prohibit non-stormwater discharges to storm drains and require controls to reduce the discharge of pollutants from storm drains to the maximum extent practicable. The discharge of pollutants to storm drains is a largely urban non-point source pollution problem that is to be addressed by structural and non-structural improvements and activities. Rather than setting numerical effluent limits, the regulations encourage the management of stormwater through Best Management Practices (BMPs). BMPs aim to reduce erosion, manage chemicals, remove pollutants through maintenance practices including street sweeping, and educate the public in behaviors that place water quality goals at risk.

Specifically, the NPDES Phase II requires implementation of six minimum control measures. The rules require the permittee (i.e., the City) "to identify and submit to the NPDES permitting authority a list of BMPs that will be implemented for each minimum control measure. They also must submit measurable goals for the development and implementation of each BMP" (Federal Register, 1999). "In other words, EPA would expect Phase II permittees to tailor their stormwater management plans and their BMPs to fit the particular characteristics and needs of the permittee…." In addition, the permittee must show a schedule for implementing the program and definition of entity responsibility.

The six minimum controls with examples of appropriate BMPs are as follows:

1. **Public Education and Outreach** - Distribute brochures, flyers, or bill inserts to educate homeowners and business operators about the problems associated with stormwater runoff and the steps they can take to reduce pollutants in stormwater discharges.

2. **Public Participation/Involvement** - Provide notice of stormwater management plan development and hold meetings at which citizens and business operators are encouraged to communicate ideas. Include citizen and business representatives in a Citizens' Advisory Group.

3. **Illicit Discharge Detection and Elimination** - Inventory and map the stormwater system and test for the possible cross-connections of sanitary wastewater to the stormwater conveyance system. Modify system to eliminate illicit discharges.

4. **Construction Site Runoff Control** - Require the implementation of erosion and sediment controls, and control other waste. Review site plans and perform periodic inspections. Establish penalties for non-compliance.

5. **Post-Construction Runoff Control** - Require the consideration and implementation of post-construction stormwater controls for any new construction. This might include on-site detention, pollutant reduction, or both.

6. **Pollution Prevention/Good Housekeeping** - Train maintenance staff to employ pollution prevention techniques and to maintain and operate public facilities to ensure the most efficient pollutant reduction. Materials handling, fleet vehicle maintenance, and application of chemicals in public areas, such as parks and roadways, should be managed to reduce impact on stormwater quality.

The Oregon Department of Environmental Quality (DEQ) is the NPDES permitting authority in the state of Oregon. The DEQ will be writing the Phase II NPDES permits with review and required approval from the EPA. The City will be required to submit a permit application or Notice of Intent by March 2003. The City must fully develop and implement a program within 5 years of issuance of the permit. Within the planning period, it is anticipated that Corvallis will be large enough to qualify as an urban area and will be subject to Phase II evaluation. The DEQ has not yet completed the task of implementing all Phase II regulations.

3.7.2 Total Maximum Daily Load

The CWA requires that each state implement activities to protect the quality of its rivers, streams, and other water bodies. The DEQ has primacy for implementing this law, including the responsibility for developing standards to protect the beneficial uses that have been determined for each water body. The DEQ developed the 303(d) list to identify water bodies that do not meet current standards. Once a water body has been listed, local governments are responsible for working with the

DEQ to develop and implement recovery plans to protect the beneficial uses. See Table 3-3 for the Willamette River and Marys River sections listed by the DEQ.

The DEQ will develop Total Maximum Daily Load (TMDL) levels for each stream on the 303(d) list within 10 years of its listing. TMDLs define the quantity of pollutant that can enter a water body without violating water quality standards. TMDLs apply to both point (end of pipe) and non-point (stormwater runoff) sources, and include a factor of safety to account for uncertainty and allow for some future discharges into the water body. TMDLs have not yet been established for Marys River or the Upper Willamette Basin. The DEQ is scheduled to complete these by 2003. To date, a lack of resources has restricted the DEQ's ability to complete the necessary studies within the specified timeframe.

Table 3-3. DEQ 303(d) Listings

DEQ record ID	Boundary	Parameter/criteria	Basis for consideration
Willamette River (Upper Willamette Basin)			
5867	Calapooia River to Long Tom River	Temperature/rearing 64° F	Summer values exceed temperature standard 64° F.
6043	Calapooia River to Long Tom River	Bacteria/water contact recreation	12 percent of the samples exceeded fecal coliform standard (400 count/100ml)
7090	Calapooia River to Long Tom River	Toxics/tissue-mercury	Health Division consumption health advisory issued for mercury in fish tissue (0.63 ppm); reference level (0.35 ppm)
Marys River			
5920	Mouth to Greasy Creek	Temperature/rearing 64° F	Summer values exceed temperature standard 64° F.
6055	Mouth to Greasy Creek	Bacteria/water contact recreation	Values exceed fecal coliform standard (400 count/100 ml) with a maximum value of 2,400 count/100 ml
6300	Mouth to Greasy Creek	Flow modification	Low flows have been suggested as cause of cutthroat population decline

Once TMDLs have been established for a water body, the DEQ will require the preparation of a comprehensive watershed plan that will define how the water body will be brought into compliance with water quality standards. The plan must address all activities within the watershed that could impact water quality, including industrial and municipal treatment facility discharges, agricultural and irrigation flows, stormwater runoff, construction site erosion, streambank shading, and land development methods. In addition, the plan must be prepared in accordance with federal and State laws.

3.7.3 Endangered Species Act

The Endangered Species Act (ESA) was enacted to prevent extinction of certain species of fish, wildlife, and plants that have seen significant declines in their populations within a defined geographic range or Evolutionarily Significant Unit (ESU). The rules prohibit a "take," which the ESA defines as "harass, harm, pursue, hunt, shoot, wound, trap, capture, or collect, or attempt to engage in any such conduct." The rules go into effect immediately upon listing by the government. The term "harass" is further defined as any intentional or negligent act that creates the likelihood of injuring wildlife by disrupting normal behavior such as breeding, feeding, or sheltering, whereas "harm" is an act that either kills or injures a listed species. By definition, "take" and "harm" can include any habitat modification or degradation that significantly impairs the essential behavioral patterns of fish or wildlife.

The National Marine Fisheries Service (NMFS), a section within the National Oceanic and Atmospheric Administration (NOAA), is responsible for administering the ESA rules as they apply to marine fish species. The U.S. Fish and Wildlife Service (USFWS) protects freshwater fish and all other animal and plant species.

ESA requirements apply to any activity that could result in a take of an endangered species. According to the NMFS, "Any government body authorizing an activity that specifically causes take may be found to be in violation of the Section 9 take prohibitions." Corvallis manages a number of activities that could potentially impact endangered species, including:

- Planning and zoning
- Development permitting
- Erosion and sediment control
- Floodplain management
- Water use
- Stormwater discharge
- Wastewater discharge
- Road and bridge construction and maintenance
- Pesticide, herbicide, fertilizer, and other chemical use
- Riparian area protection, alteration, or development
- Wetland protection, alteration, or development

In addition, NMFS and the USFWS have a policy to identify specific activities considered likely to result in take. As indicated in the *Federal Register* "Notice of Threatened Status for Two ESUs of Steelhead in Washington and Oregon" (U.S. Department of Commerce, March 1999), such activities include, but are not limited to:

1. Destroying or altering the habitat of listed salmonids (through activities such as removal of large woody debris or riparian shade canopy, dredging, discharge of fill material, draining, ditching, diverting, blocking, or altering stream channels or surface or ground water flow).

2. Discharging or dumping toxic chemicals or other pollutants into waters or riparian areas supporting listed salmonids.

3. Violating federal or State CWA discharge permits.

4. Applying pesticides and herbicides in a manner that adversely affects the biological requirements of the species.

5. Introducing non-native species likely to prey on listed salmonid species or to displace them from their habitat.

3.7.3.1 Enforcement

Enforcement of ESA rules will be by the NMFS under Section 9 of ESA. Also, third parties may bring suit under Section 9 against the entity or person alleged to have committed a take. A take permit or a 4(d) take limit is not required if a take does not occur. However, an entity or person will be at risk of violating the rules unless a certainty of compliance is provided as offered under Section 4(d), Section 10, or the federal nexus.

3.7.3.2 Listed Wildlife and Plants

Listings define the status of the species as endangered, threatened, or not warranted. Endangered is defined as, "in danger of extinction throughout all or a significant portion of its range," while threatened means, "likely to become endangered within the foreseeable future throughout all or a significant portion of its range." Two species of fish have been listed for the Corvallis area:

- Oregon Chub, Oregon ESU — Endangered
- Chinook salmon, Upper Willamette River ESU — Threatened

The USFWS has listed 28 species of plants and animals as endangered or threatened in Oregon. The City may request a report from the Oregon Natural Heritage Program that lists species identified in the Corvallis area. Regardless, the determination of whether any of the listed species are in a particular area is the responsibility of the owner/developer of the land. In addition, listings can change; therefore, it is imperative that the owner/developer of a property determine the applicable listings at the time of the proposed activity.

3.7.3.3 Complying with the Endangered Species Act

The final rules defining the NMFS requirements for conserving the listed steelhead and salmonid ESUs were published in the *Federal Register* on July 10, 2000. The discussion presented in this document is based on the final rules and on information gathered through discussions with the NMFS and others involved in the 4(d) exemption process. The final 4(d) rules for the different ESUs have different effective dates. The effective date for the salmon ESUs is January 8, 2001.

A number of jurisdictions, including Corvallis, are negotiating with NMFS to define the programs that would be required to provide eligibility for the 4(d) exemption. NMFS will apply the following 12 evaluation considerations when reviewing Municipal, Residential, Commercial, and Industrial (MRCI) development ordinances or plans to assess whether they adequately conserve listed salmonids by maintaining and restoring properly functioning habitat conditions:

1. Ensures that development will avoid inappropriate areas such as unstable slopes, wetlands, areas of high habitat value, and similarly constrained sites.

2. Adequately avoids stormwater discharge impacts to water quality and quantity or to the hydrograph of the watershed, including peak and base flows of perennial streams.

3. Adequately protects riparian area management requirements to attain or maintain properly functioning conditions (PFC) around all rivers, estuaries, streams, lakes, deepwater habitats,

and intermittent streams. Compensatory mitigation is provided, where necessary, to offset unavoidable damage to PFC due to MRCI development impacts to riparian management areas.

4. Avoids stream crossings by roads, utilities, and other linear development wherever possible. In addition, where crossings must be provided, minimizes impacts through choice of mode, sizing, and placement.

5. Adequately protects historical stream meander patterns and channel migration zones, and avoids hardening of stream banks and shorelines.

6. Adequately protects wetlands and wetland functions, including isolated wetlands.

7. Adequately preserves the hydrologic capacity of permanent and intermittent streams to pass peak flows.

8. Includes adequate provisions for landscaping with native vegetation to reduce the need for watering and application of herbicides, pesticides, and fertilizers.

9. Includes adequate provisions to prevent erosion and sediment runoff during construction.

10. Ensures that water supply demands can be met without impacting flows needed for threatened salmonids, either directly or through groundwater withdrawals, and that any new water diversions are positioned and screened in a way that prevents injury or death of salmonids.

11. Provides necessary enforcement, funding, reporting, implementation mechanisms, and formal plan evaluations at a minimum of every 5 years.

12. Complies with all other State and federal environmental and natural resource laws and permits.

The NMFS recommends a "plug and play" approach to meeting the 4(d) requirements. Jurisdictions would produce plans to be reviewed by the NMFS. If approved, the plans would be published in the Federal Register and made available for others to adopt. While adoption in this manner would save new applicants considerable time and effort in developing a compliance plan, the plan must still be tailored to meet the specific needs of the listed species within the applicant's jurisdiction. The NMFS must review and approve the modified plan before it can provide protection against take.

Although there is currently no prototype format for a stormwater management plan to serve as a 4(d) limitation on the take prohibitions, the NMFS is requesting that cities meet with them to discuss ways in which their programs can serve as an application for a 4(d) limitation on the take prohibitions. Other than applicable Section 7 consultation requirements, the NMFS does not have authority to require review of a city's stormwater management plan. However, receiving a limit on the take prohibitions under section 4(d) would provide legal assurance to the City that it would not be subject to an NMFS enforcement action or a third-party lawsuit.

3.7.3.4 Corvallis Endangered Species Act Planning

The City is undertaking a separate work effort to address the community's response to the Endangered Species Act. The work consists of collecting data, conducting inventories, and applying scientific methods to evaluate fish habitat impacts. Options and strategies will be developed to prevent further habitat degradation. Results of this effort may coincide with many of the recommendations contained within this document.

3.7.4 Floodplain Management

Congress initiated the National Flood Insurance Program (NFIP) in 1968 to control costs to all levels of government due to flood disaster relief. The Federal Insurance Administration, part of the Federal Emergency Management Agency (FEMA), administers the NFIP. The NFIP insurance coverage is available only in communities that implement regulations to reduce the likelihood of future flood damage. Zoning laws, building codes, and development regulations serve to manage the floodplain by setting restrictions and requirements for new construction within flood-prone areas.

Congress modified NFIP in 1973. Funds related to federal programs that involve structures within the 100-year floodplain can be granted only if the structure is covered under a flood insurance policy and the community participates in the NFIP.

The National Flood Mitigation Fund was set up by the FEMA as the result of 1994 legislative reforms. The FEMA can fund planning and actual projects on a cost-sharing basis of 25 percent state and local funding and 75 percent federal funding, contingent on the development of a flood mitigation plan.

Current FEMA regulations define two flood zones:

> **Floodway** – Part of the 100-year floodplain that must be kept clear of fill or other obstructions to convey the 100-year flood without an excessive increase in flood elevations
>
> **Floodway fringe** – Portion of the 100-year floodplain outside of the floodway. This may be developed if the fill does not cause the 100-year flood elevation in the floodway to rise more than 1 foot.

Corvallis has its own definition for floodway and floodway fringe. See section 5.4.5, Floodplain Management, in Chapter 5.

To enter the regular NFIP program, a community must complete a detailed technical study of flood hazards. A floodplain study determines the elevations of floods of varying intensity and the floodway boundaries. This information is presented on a Flood Insurance Rate Map and Flood Boundary and Floodway Map. The community adopts and enforces regulatory standards based on these maps.

Physical data developed as part of the SWMP's hydrologic/hydraulic modeling could be used to update or develop FEMA maps. However, most master planning efforts do not provide the level of technical analysis required to satisfy the FEMA requirements. As part of a FEMA update, maps could be developed that account for planned improvements to the stormwater drainage system. This could be advantageous to the community if the actual 100-year floodplain is less extensive than currently shown on FEMA maps, resulting in a reduction in the area that is impacted by FEMA requirements.

3.7.5 Wetland Management

Section 10 of the Rivers and Harbors Act of 1899 requires approval prior to work in or over "navigable waters" of the United States, or to work that affects the course, location, condition, or capacity of such waters. The U.S. Army Corps of Engineers (COE) is responsible for administering the Act. By definition, the wetlands and streams in and around Corvallis are covered by this requirement. Typical activities requiring Section 10 permits are:

- Construction of piers, wharves, bulkheads, marinas, ramps, floats, intake structures, and cable or pipeline crossings.
- Dredging and excavation.

Section 404 of the CWA requires approval prior to discharging dredged or fill material into the "waters of the United States." The COE is also responsible for administering Section 404 of the CWA. Again, "waters of the United States" includes essentially all surface waters such as all navigable waters and their tributaries, all interstate waters and their tributaries, all "wetlands adjacent" to these waters, and all impoundments of these waters. Typical activities requiring Section 404 permits are:

- Depositing of fill or dredged material in waters of the U.S. or adjacent wetlands.
- Site development fill for residential, commercial, or recreational developments.

As defined in Section 404, wetlands are:

> Those areas that are inundated or saturated with surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.

In addition to the COE, the Oregon Division of State Lands (DSL) regulates activities in wetlands. The primary state regulation that affects development activities in and near wetlands is the Removal-Fill Permit Program, ORS 196.800 through 196.990, administered by the DSL. The DSL uses the 1987 COE manual to delineate wetlands.

The Removal-Fill Permit Program regulates:

- The removal of 50 cubic yards or more of material from one location in any calendar year.
- The filling of a waterway with 50 cubic yards or more of material at one location at any time.

The DSL also regulates irrigation ditches and intermittent streams if they are considered a source of food for wildlife or provide habitat for game fish. Further, the DSL regulates intermittent streams if they meet federal wetlands criteria.

Any public or private project that involves filling or removing fill from wetlands included in the Corvallis wetland inventory requires a DSL permit if the quantities exceed 50 cubic yards. The City's Wetland Factors Map identifies hydric soils (often a wetland indicator) and National Wetland Inventory wetlands. In addition, the City has conducted basin-wide wetland inventories for Squaw Creek, Jackson Creek, and Frazier Creek. The basin-wide inventories identify the probable wetland locations. The absence of wetlands, streams, and drainage channels on inventory maps does not automatically relieve the owner or developer of acquiring permits. Wetlands can be present on a site and not appear on an inventory map. The owner or developer must determine if wetlands are present and determine whether a DSL permit is required.