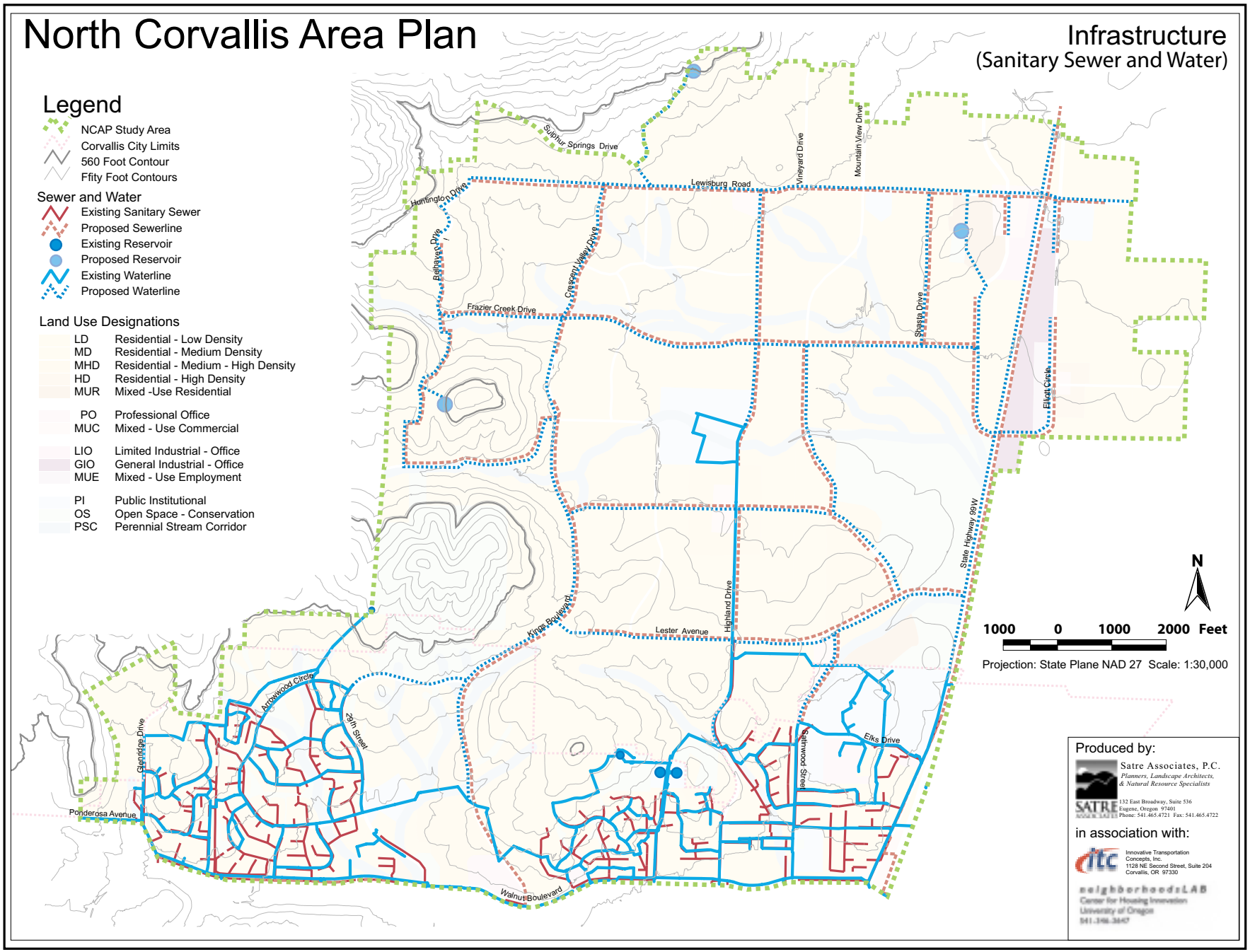


Figure 6.1 *NCAP proposed expansion to the sanitary sewer and potable water distribution system.*

Chapter 6: Infrastructure

6.1 Overview

As part of a commitment to integrating land use and transportation systems with natural resource conservation, the NCAP seeks to establish new stormwater infrastructure standards as part of the project's overall approach to providing necessary public infrastructure for future urban development. In the "green infrastructure" approach proposed, the NCAP incorporates open storm drainage systems and Best Management Practices in all urban development, as a possible alternative to traditional piped drainage. These open drainages more closely emulate natural hydrologic regimes to mitigate the deleterious effects of urbanization on receiving streams and maintain the integrity of existing watersheds and habitats.

Water, wastewater, electric and gas utilities will still be extended to serve future development in the planning area through traditional means. But the proposed model for stormwater drainage, termed "green infrastructure," reduces impervious surfaces and retains existing vegetation as much as practicable. Studies have linked higher impervious surfaces to changes in stream geometry, water quality, water temperature and the health of aquatic species and wildlife that rely upon natural waterways and riparian vegetation.

6.1.1 Guiding Principles

Guiding principles for the NCAP project outlined in Chapter 1 provide fundamental considerations relating to the provision and timing of infrastructure extension. Of greatest relevance are Guiding Principles 3 and 4, which respectively call for, among other things, concentrated and properly sequenced development and development patterns that fit within the area's landscape.

Under the auspices of the project's guiding principles, NCAP infrastructure proposals are predicated on the direction established in the City's adopted 1998 Water Distribution Facility Plan, 1998 Wastewater Utility Master Plan, and 1982 Corvallis Drainage Master Plan. The City is in the process of developing an updated stormwater master plan, and direction provided by this project's TAC and CAC was critical in the development of the NCAP's infrastructure recommendations.

6.1.2 Assumptions

NCAP strategies relative to the development, extension, and timing of public infrastructure are based upon the following assumptions:

- Statewide planning Goals 11 and 14 require planning for infrastructure systems and future development through build-out of the Corvallis UGB; it is assumed that the current location of the UGB in the NCAP area will neither expand nor contract.
- Development will occur over time and in a sequential, planned fashion, with build-out of the Corvallis UGB assumed to occur in approximately 80 years based upon current development and demographic trends, regulatory factors, and land use planning considerations.
- Until and unless annexed into the City of Corvallis, areas in the North Corvallis Urban Fringe will remain under Benton County jurisdictional control and subject to intergovernmental agreements between the City and County under the Urban Fringe Management Agreement, and to provisions in the Benton County Code.
- Due to high capital and ongoing maintenance costs, future wastewater systems will use gravity flow and avoid the use of lift and pump stations where practical.
- Extension of urban services, including sanitary sewer service, will continue to be development driven, responding to specific development proposals and successful contiguous annexation to the City of Corvallis.

6.2 Stormwater Management and Green Infrastructure

The NCAP's use of "green infrastructure" (Figure 6.2) intends to achieve several objectives:

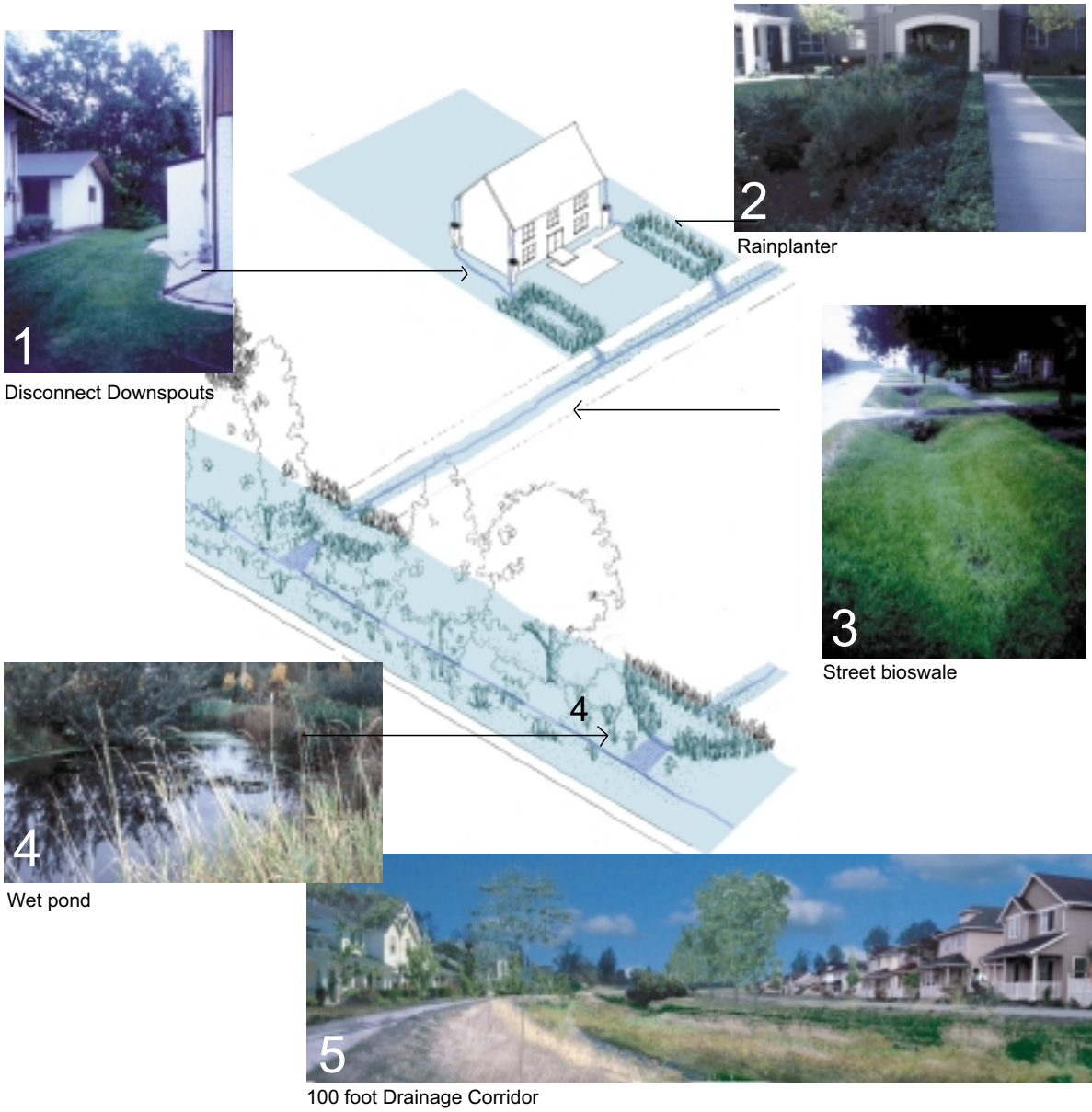
- Protect or improve the functions and values of the Jackson-Frazier wetlands and other perennial streams and wetlands in North Corvallis;
- Protect or improve the area's current watershed hydrology;
- Conserve and manage floodplains for natural storage and conveyance functions; and
- Manage stormwater from future development in the area to minimize change in surface and groundwater hydrology and to maintain or enhance water quality.

6.2.1 Conventional Stormwater Management

Conventional stormwater systems collect runoff and move it and associated pollutants through piped systems to receiving streams. The City of Corvallis has an extensive program to manage stormwater and mitigate the effects of urban development through operational means and physical improvements. These include, but are not limited to:

- Regular street sweeping of all improved public streets in the City;
- Ongoing maintenance of catch basins and other components of the City's public stormwater system;
- Leaf collection;
- Public education programs; and
- Requirements for oil/water separators and other catch basin designs in parking lot development.

GREEN INFRASTRUCTURE CONCEPT



Surface Stormwater Systems naturally filter and convey runoff from development asillustrated in the above **Stormwater Treatment Train**. **(1)** Disconnected Downspouts direct water awayfrom the house using a 2% grade. Water is then directed to **(2)** a Rain planter where vegetation and soil absorbs excess runoff and nutrients. Water from impervious street surfaces are directed to **(3)** a Street Bioswale, that allows runoff to infiltrate. Vegetation and soil absorb excess nutrients. During large storm events (greater than 10-year storm) runoff enters the piped system and directed to **(4)** a Wet Pond which is planted with wetland vegetation. Sediment, excess nutrients and other constituents of runoff are settled out in these areas before entering **(5)** the Drainage Corridor.These are but a few examples. In addition to those illustrated, many other storm water treatment concepts can be adapted to achieve similar ends.

Figure 6.2 *Green infrastructure concepts for mitigating the impact of storm water runoff. (photos & original diagram: CHI)*

While the NCAP proposes exploring innovative stormwater management methods, consideration should be given to fiscal impacts from added or lessened management and maintenance requirements beyond those assumed through conventional practices incurred by the City.

6.2.2 Green Infrastructure Stormwater Management

The green infrastructure concept first protects riparian corridors, wetlands, floodplains, and associated vegetative communities to the greatest extent possible. As part of urban development, practices are employed such as the use of bio-filtration swales and detention/filtration basins, reduction in impervious coverage, use of open drainages and constructed wetlands rather than piped systems, maximizing tree cover, use of pervious paving materials, etc. (Figure 6.3). While green infrastructure is intended to maintain water quality and stormwater runoff volumes at pre-development levels, there is a need to develop additional data to establish base line conditions to chart existing hydrologic conditions as well as monitor development impacts over time. Given the quality of the existing wetland system in the NCAP area and the importance of preserving downstream water quality as part of the City's overall strategy to protect endangered Willamette River salmonids, the benefits of the green infrastructure approach are manifest.

(a)

(b)

Figure 6.3 Existing examples of green infrastructure storm water treatment systems: (a) a bio-filtration swale in Waluga Park parking lot, Lake Oswego, OR; (b) a storm water treatment marsh at Brookhaven, Beaverton, OR. (photos: CHI)

In addition to considering the fiscal implications for public works noted above, practical application of the green infrastructure concept must accommodate site-specific conditions such as slope and soil character in selecting appropriate Best Management Practices (BMP's) proposed here. Given these concerns, the NCAP proposes to apply the use of bio-swales to roadways designated as parkways where no adjacent development is anticipated. (e.g., less than 2 dwellings/acre). Bio-swales may also be implemented along other roadways dependent upon specific site conditions.

6.3 Water, Sanitary Sewer, and Other Utilities

With limited exceptions, water and sanitary sewer utilities are currently located only within the portions of the planning area in the Corvallis city limits. Exceptions include water lines extending west of Good Samaritan Hospital and north along Highland Drive to serve Crescent Valley High School (a second level water line). Existing sanitary sewer service also extends north to the high school using a force main; the existing lift station and force main are sized for use by Crescent Valley High School and are not be able to serve additional development.

The sanitary sewer system is based on gravity flow and extends from developable areas in North Corvallis to the municipal wastewater treatment facility without the use of pump or lift stations. Pump and lift stations are not only expensive to initially develop, but carry substantial long-term costs for operation and maintenance. Although lift stations are not desirable, the City's sanitary

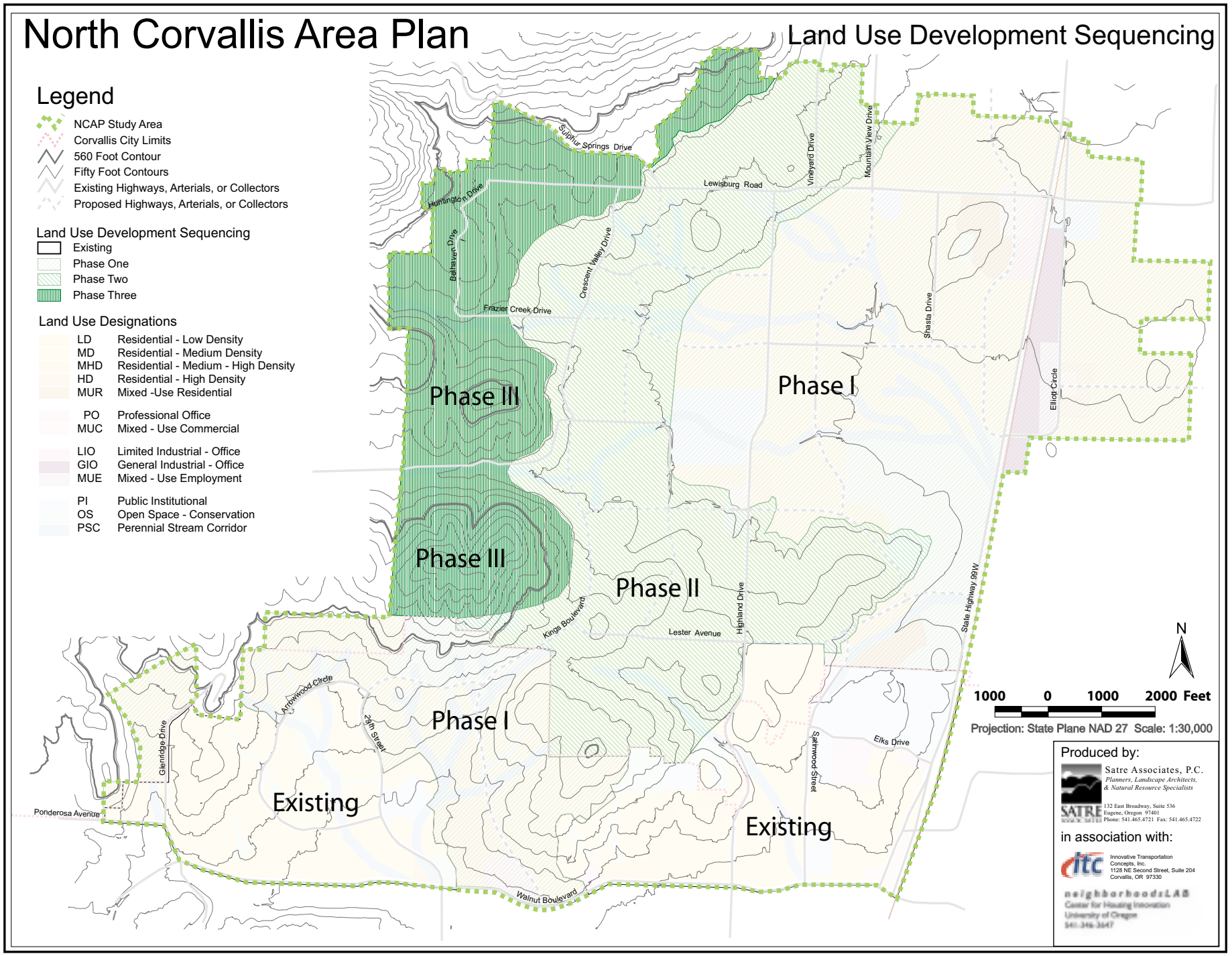


Figure 6.4 NCAP land use development sequencing diagram

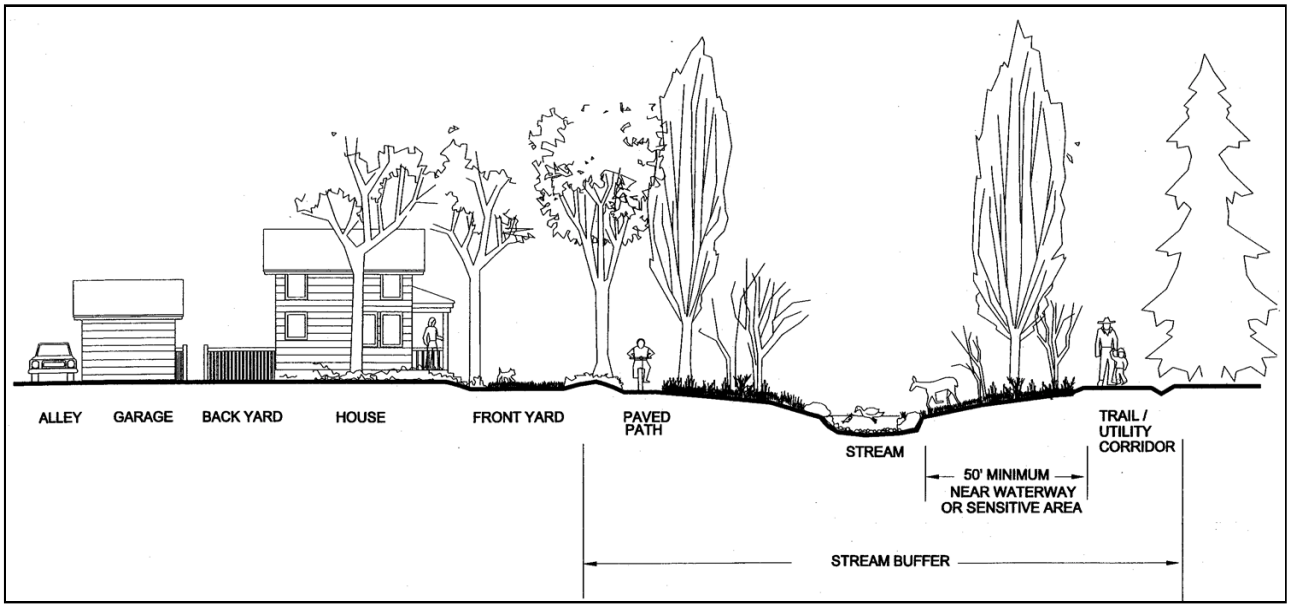


Figure 6.5 Utility corridor integrated with a multi-use trail. (illustration by Sara Geddes)

sewer master plan identifies the need for at least one (i.e., in the Lewisburg area) to provide necessary service upon annexation.

Sanitary sewer services are proposed in the NCAP to be extended concurrent with approved annexations and development plans primarily along a future street rights-of-way within major drainage basins. Future extension of sanitary sewer facilities into the NCAP area to serve urban development is intended to follow the locations described in the City's adopted water and wastewater master plans (Figure 6.4). Sanitary sewer trunk lines would be extended along future extension of Kings Boulevard to serve undeveloped areas in the Timberhill area and north along the Satinwood Street extension to serve future development west of Good Samaritan Hospital. Extension of sanitary sewer trunk lines north along Highway 99W and west through the Jackson and Frazier Creek drainage basins would serve future development north and south of the Crescent Valley High School area. Additional capacity beyond that provided currently would also need to be added along Highland Drive.

While providing gravity sanitary sewer facilities along the Jackson and Frazier Creek basins may warrant extending trunk lines along stream corridors, the NCAP proposes minimizing impacts to natural habitats and waterways. Sewer utility lines should be incorporated into east-west trending streets paralleling the Jackson and Frazier Creek drainages and/or with trail systems in easements located at the edge of drainage buffers to serve multiple uses (Figure 6.5). This would require trails to be developed to support maintenance vehicles as well as meeting standard trail design parameters, and could pose issues of occasional user inconvenience associated with system maintenance activities.

Other utilities are not as constrained as to location. The NCAP proposes extending water service, where possible, along street rights-of-way in locations generally consistent with the City's water master plan, and assumes that other utilities (natural gas, underground electric service, telephone and TV/data cabling) would follow water services in utility easements and rights-of-way. The Water Plan also proposes three future water storage reservoirs located in the higher elevations of the planning area. Also consistent with the adopted Corvallis water system master plan, the NCAP identifies that extension of water service will be developed through a phased approach based upon population demand for services, and service area elevations tied to topographic elevations in the area.

Like sanitary sewer service, extension of these utilities is development-driven and contingent upon being contiguous to the Corvallis city limits and subject to voter-approved annexation for areas in the Corvallis urban fringe.

6.4 School Facilities

Apart from the more traditionally considered urban infrastructure systems (i.e., water, electric, gas sanitary sewer, and stormwater management services), NCAP also factored in the need for another key service necessary for comprehensive urban development: public schools. With additional population growth over time, it is anticipated that additional school facilities may need to be developed. The NCAP proposes to locate a new school site near both the existing high school and a proposed community park to: 1) maximize the use of scarce resources for land acquisition; 2) allow for shared maintenance costs by sharing land for active park and recreation areas, and school play space; and 3) incorporate natural features into the program for school development, curriculum and instruction. The precise location of future schools may differ from the generalized location shown on the NCAP Plan Diagram based upon facility demands, land costs and configuration, and other issues that will be addressed more fully as the area develops. (See Figures 3.1 & 3.6)

6.5 Recommendations

Readers and users of this plan are encouraged to review this entire chapter as well as the following recommended actions, and to develop additional actions, as means to achieve the planning and design objectives presented in this chapter and in the NCAP document as a whole.

6.5.1 Stormwater Management

I1. Employ on-site stormwater management practices for detention and filtration of stormwater on development sites, appropriate roadways and parkways, and public lands to minimize post-development change in the quality and quantity of off-site runoff. Work to retain pre-development water quality and quantity by using the 1998 Corvallis Comprehensive Plan's "Significant Degradation" policy regarding water quality.

I2. Encourage multiple on-site, small-scale interventions and treatment opportunities to meet the City's current standards for stormwater detention where feasible. Two examples are:
- Water "harvesting" for irrigation use, and
- On-site filtration, detention basins.

I3. Establish code requiring filtration of stormwater runoff produced by two-year or smaller storm events.

I4. Encourage stormwater management practices such as the use of surface drainage and the following natural Best Management Practices (BMPs) where feasible considering localized soil conditions (Figure 6.6).
- Bio-filtration swales
- Eco-roofs
- Compost filters
- French drains
- Disconnected roof drains
- Pervious pavement

(a) *(b)* *(c)*

Figure 6.6 Existing examples of green infrastructure storm water mitigation concepts: (a) an eco-roof at the Hamilton Building, Portland, OR; (b) a grass swale in Village Homes, Davis, CA; (c) pervious paving. (photos: CHI)

- Rain planters
- Vegetated filter strips
- Wet ponds
- Stormwater treatment marshes
- Use structural BMPs only as necessary in higher density areas,
- consider modifying code standards to allow for pervious paving in alleys where feasible.

I5. Maintain or increase tree canopy cover in the NCAP area by establishing tree replacement based on percentage of canopy cover removed rather than number of trees.

I6. Set standards for tree canopy cover in commercial, office, public, and industrial applications.

I7. Encourage reductions of overall street area, particularly paved areas, by employing standards for narrow local street widths (as defined in the Transportation Master Plan), designing street networks that provide adequate levels of connectivity, and maintaining high levels of pedestrian and bicycle connectivity. Target an overall maximum of 15% effective impervious surface area within the NCAP planning area.

I8. Keep the frequency of roadway stream crossings to a minimum, and where unavoidable use structures designed for free movement of flood waters.

I9. Enforce state regulations for erosion control regarding stormwater management plans for sites five acres or larger; consider developing more stringent local standards.

I10. Explore means to provide incentives for floodplain enhancement and restoration through the development process.

I11. Manage protected natural areas and natural stormwater facilities for multiple uses where possible (e.g., for habitat protection as well as stormwater management) and allow trails and interpretive facilities proximate to ponds, wetlands, stream corridors, drainage channels and swales so long as those facilities do not degrade natural resources or their functions.

I12. Provide only limited exceptions for development within the 100-year floodplain (e.g., demonstration that development does not significantly restrict or alter flow patterns or flood storage, or degrade water quality.)

I13. Coordinate with local agencies, such as the area watershed council, Benton Soil and Water Conservation District, and others to develop a system of resource benchmarks for water quality, surface water hydrology, and other measures. Develop protocols for long-term monitoring to asses baseline conditions and guide descision making in the planning area.

I14. Provide an aggressive community education program that encourages water-quality sensitive landscape, building, and site management practices.

I15. Secure dedications for development in the City or easements for development in the County along drainage ways for stormwater management and utility access through the land division and development review processes.

I16. Use the development review process to ensure that development proposals plan stormwater facilities "to and through" proposed development areas to extend stormwater connections to adjacent properties.

I17. Recommend further, detailed hydrologic studies in the NCAP area to better understand natural drainage systems.

6.5.2 Water, Sanitary Sewer, and Other Utilities

I18. Ensure through the development review process that new water and sewer utilities are extended "to and through" development areas and are available to serve future development on adjoining parcels.

I19. Have development submittals include plans for future utility extension sized and located consistent with the potential for future development outlined in the NCAP and City master plans.

I20. Where not able to be located in street rights-of-way, have sanitary sewer lines align with trail corridors for multiple-use and minimize riparian impacts; seek to develop and locate utility lines to minimize vegetative disturbance and environmental impact, and ensure that multi-use trails are designed and surfaced to support the weight of maintenance vehicles.

I21. Secure dedications in the City limits or easements within the County for development along drainage ways for wastewater extension and utility access through the land division and development review processes.

I22. Provide future sanitary sewer extensions based upon use of gravity systems; avoid service extension that requires pump stations due to increased long-term operational and maintenance costs.

I23. Locate necessary utility lines (e.g., water, gas, power, cable) within street rights-of-way unless demonstrated to be infeasible.

6.5.3 School Facilities

I24. Locate future school facilities proximate to Crescent Valley High School and/or to a park land to take advantage of shared use of facilities, and economies of scale for land acquisition and maintenance.

I25. Establish a minimum 200-foot setback for new school structures from fault lines identified in the Advisory Constraints Map.