

Final Supplemental Environmental Impact Statement

Urban Growth Area Update



Lead Agency
Spokane County
Department of Building and Planning
Spokane, Washington

December 21, 2011



BUILDING AND PLANNING DEPARTMENT

1026 WEST BROADWAY AVENUE
SPOKANE, WA 99260

December 21, 2011

Subject: Final Supplemental Environmental Impact Statement (FSEIS) for Spokane County
Urban Growth Area Update

Dear Interested Reader:

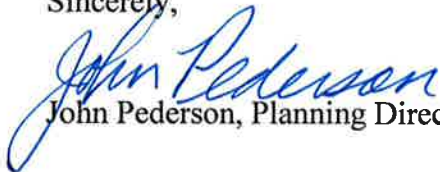
Attached is a copy of the Final Supplemental Environmental Impact Statement (FSEIS) for Spokane County's Urban Growth Area (UGA) update. This document is intended to provide information to elected officials, affected agencies and the general public to aid in the decision making process for updating the UGA under the Washington State Growth Management Act (RCW 36.70A).

The document contains a description of the proposed action and a description of a range of alternative UGA options. The Final SEIS provides responses and information from the comments generated by the Draft Supplemental Environmental Impact Statement (DSEIS). A total of 18 comment letters were received on the DEIS.

The Planning Commission for Spokane County has tentatively scheduled a public hearing on the UGA update for January 26, 2012 at 9:00 a.m. in the Spokane County Board of County Commissioners Hearing Room, 1026 W Broadway Ave, Spokane, WA.

For information contact Steve Davenport at (509) 477-7221, Division of Building and Planning, 1026 W Broadway Ave, Spokane, WA.

Sincerely,


John Pederson, Planning Director

NOTICE OF AVAILABILITY
FINAL SUPPLEMENATAL ENVIRONMENTAL IMPACT STATEMENT (FSEIS)

Washington Administrative Code, 197-11-460, 197-11-680

Spokane County hereby issues the Final Supplemental Environmental Impact Statement (FSEIS) for the Spokane County GMA Comprehensive Plan Urban Growth Area Update consistent with the requirements of WAC 197-11-460. The FSEIS is an integrated SEPA/GMA document developed under WAC 197-11-210.

Description of Proposal: The proposal is a non-project SEPA/GMA action for the review of Spokane County's Urban Growth Area (UGA) in accordance with the review cycle required by the Growth Management Act (GMA), RCW 36.70A.130. The proposal examines the adequacy of the County's Urban Growth Area and its ability to provide for future growth. The action includes amendment to the Spokane County Comprehensive Plan should modification of the UGA be deemed necessary. Four alternative land use scenarios are evaluated in the FSEIS.

Proponent: Spokane County

Location of Proposal: Spokane County, Washington

Lead Agency: Spokane County Department of Building and Planning.

The Final Supplemental Environmental Impact Statement (FSEIS) has been prepared under RCW 43.21C.030 (2)(c).and can be reviewed at our offices at the Spokane County Department of Building and Planning, 1026 W. Broadway Avenue, Spokane, WA 99260 or on our website at www.spokanecounty.org/bp. The electronic document can also be viewed at ftp.spokanecounty.org/UGAupdate. Hard copies of the FSEIS or a CD version of the FSEIS will be provided for cost of reproduction.

Responsible Official: John Pederson

Position/title: Planning Director for Spokane County

Address: 1026 W. Broadway Avenue, Spokane, WA 99260

Phone: (509) 477-7224

Date: December 21, 2011

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Fact Sheet

PROJECT TITLE

Spokane County Urban Growth Area Update

PROPOSED ACTION

The proposed action is the review of Spokane County's Urban Growth Area in accordance with the review cycle required by the Growth Management Act (GMA), RCW 36.70A.130 and by the Spokane County Countywide Planning Policies, Urban Policy 16; and the Spokane County Comprehensive Plan, Policy UL.18.1. The proposal considers possible amendments to the County's Comprehensive Plan and Zoning Map. The proposed action is the first phase of a phased approach to meet the requirements of RCW.36.70A.130. The proposal examines the adequacy of the County's Urban Growth Area and its ability to provide for future growth. A description of proposed alternatives is included in Chapter 1 of this document. Future phases will consider other requirements of RCW.36.70A.130.

LOCATION

The proposal encompasses all of unincorporated Spokane County. Spokane County is located in eastern Washington State. As of the 2010 census the population was 471,221, making it the fourth most populous county in Washington State. The largest city and county seat is Spokane, the second largest city in the state, behind Seattle.

PHASED ENVIRONMENTAL REVIEW

The proposed action is the first phase of a phased approach to meet the requirements of RCW.36.70A.130. The proposal examines the adequacy of the County's Urban Growth Area and its ability to provide for future growth for the 20 year planning period. Future phases will consider other requirements of RCW.36.70A.130.

PROPONENT

Spokane County

DATE OF IMPLEMENTATION

Winter 2012, Adoption by Spokane County Board of Commissioners

LEAD AGENCY

Spokane County Department of Building and Planning
1026 W Broadway Avenue
Spokane, WA 99260

RESPONSIBLE OFFICIAL

John Pederson, Planning Director
Spokane County Department of Building and Planning
1026 W Broadway Avenue
Spokane, WA 99260

REQUIRED APPROVALS

Adoption by the Spokane County Board of County Commissioners; review and comment by Washington State Department of Commerce as required by the State of Washington Growth Management Act.

FEIS AUTHORS AND PRINCIPAL CONTRIBUTORS

The Final SEIS has been prepared by the Spokane County Department of Building and Planning.

Principal Authors:

Spokane County Department of Building and Planning

Spokane County Planning Technical Committee

Spokane Regional Transportation Council

DATE OF FINAL SEIS ISSUANCE

The Final SEIS will be issued December 21, 2011

PUBLIC HEARING

The Planning Commission for Spokane County has tentatively scheduled a public hearing on the UGA update for January 26, 2012 at 9:00 a.m. in the Spokane County Board of County Commissioners Hearing Room, 1026 W Broadway Ave, Spokane, WA.

PREVIOUS ENVIRONMENTAL DOCUMENTS

Prior phases of environmental review have included programmatic environmental information and guidance for the cities' and County's planning activities. Spokane County has published the following environmental documents addressing alternative urban growth areas and comprehensive plan proposals and these documents are adopted by reference under WAC 197-11-980 and Section 11.10.23(2) of the Spokane Environmental Ordinance:

- Alternative Interim Urban Growth Area Boundary Draft and Final Environmental Impact Statements (1996);
- Interim Urban Growth Area Boundary Addendum to the Final Environmental Impact Statement (1999);
- Comprehensive Plan Supplemental Draft and Final Environmental Impact Statements (2000 and 2001)

This integrated SEPA/GMA SEIS adopts and builds on the prior environmental review conducted in the above documents and uses that information to evaluate proposed changes to the urban growth area and associated land use designations. This SEIS represents another phase in planning and environmental review. It was prepared to provide information about the current proposal and to assist decision-makers in making informed decisions about future growth and development.

LOCATION OF BACKGROUND INFORMATION

Spokane County Department of Building and Planning.
1026 W. Broadway Avenue
Spokane, WA 99260
(509) 477-3675

FINAL SEIS PURCHASE PRICE

A hard paper copy of the Draft SEIS is available for Cost of production plus tax, shipping and postage. The CD version of the Draft SEIS is available for cost of production plus tax. Available at the Spokane County Department of Building and Planning office located at 1026 W Broadway Avenue, Spokane, Washington. The Draft SEIS is also available on the Spokane County Website at www.spokanecounty.org/bp.

Distribution List

Federal Agencies

U.S. Army Corps of Engineers, Eastern Washington Office, Tim Erkel
U.S. Fish & Wildlife Service, Ecological Services, Russ Macrae, Assist. Project Leader

State/Regional Agencies

Kootenai County, Idaho, Planning Department
Lincoln County Planning Department
Stevens County Planning Department
Whitman County Planning Department
Pend Oreille County Planning Department
Spokane County Planning Technical Advisory Committee (PTAC)
Spokane Regional Clean Air Agency, Chuck Studer
Spokane Regional Health District, Steve Holderby
Spokane Regional Transportation Council, Kevin Wallace
Spokane Transit Authority, Gordon Howell
Washington State Department of Archaeology, Gretchen Kaehler
Washington State Department of Commerce (Formerly CTED)
Washington State Department of Corrections, Eric Heinitz
Washington State Department of Ecology, Environmental Review
Washington State Department of Fish and Wildlife, SEPA Unit
Washington State Department of Health
Washington State Department of Natural Resources, SEPA Coordinator
Washington State Department of Transportation – Aviation Division, Carter Timmerman
Washington State Department of Transportation, Greg Figg

Cities

City of Airway Heights Planning Department
City of Airway Heights, Community Development Director
City of Cheney Community Development
City of Deer Park
City of Liberty Lake Community Development
City of Medical Lake Community Building & Planning
City of Spokane Engineering Services
City of Spokane Planning Services
City of Spokane Valley, Planning Department
Town of Fairfield
Town of Latah
Town of Millwood Planning Department
Town of Rockford
Town of Spangle
Town of Waverly

School Districts

Central Valley School District #356
Cheney School District
East Valley School District
Educational Service District 101
Mead School District
Medical Lake School District
Spokane School District #81
West Valley School District

Fire Departments

City of Spokane Fire Department
Spokane County Fire District #1
Spokane County Fire District #2
Spokane County Fire District #3
Spokane County Fire District #4
Spokane County Fire District #5
Spokane County Fire District #8
Spokane County Fire District #9
Spokane County Fire District #10
Spokane County Fire District #11
Spokane County Fire District #12
Spokane County Fire District #13

Tribes

Kalispell Tribe of Indians
Spokane Tribe of Indians

Utilities

Avista Utilities
Carnhope Irrigation District
City of Spokane Solid Waste Management
City of Spokane Water Department
Consolidated Irrigation District #19
East Spokane Water Dist. #1
Hangman Hills Water Dist. #15
Hutchison Irrigation District
Kaiser North Area Water Dist.
Inland Power and Light
Liberty Lake Water District
Moab Irrigation District
Model Irrigation District
Modern Electric Water Company
Newman Lake Watershed
North Spokane Irrigation District
Orchard Ave. Irrigation District

Pasadena Park Irrigation District
Spokane County Water District #3
Trentwood Irrigation District
Whitworth Water District #2
Vera Water and Power

Spokane County Departments

Spokane County Board of County Commissioners
Spokane County Boundary Review Board
Spokane County Regional Clean Air Agency
Spokane County Community Services, Housing and Community Development Department
Spokane County Division of Engineering, Development Services
Spokane County Division of Engineering, Transportation Engineering
Spokane County Division of Utilities
Spokane County Division of Utilities, Water Resources Section
Spokane County Hearing Examiner
Spokane County Planning Commission
Spokane County Regional Animal Protection Services
Spokane Regional Health District
Spokane County Sheriff
Spokane County Stormwater Utility
Spokane County Parks, Recreation and Golf

Libraries

City of Spokane Public Library
Spokane County Public Libraries

Other

Burlington Northern Santa Fe Railroad
Center for Justice
Fairchild Air Force Base, Base Commander
Fairchild Air Force Base, Community Planning
Futurewise
Greater Spokane, Inc.
Growth Management Steering Committee of Elected Officials
Inland Northwest Land Trust
Spokane Association of Realtors
Spokane County Homebuilders Association
Spokane County Neighborhood Associations
Spokane International Airport
Interested Parties

Introduction

Spokane County is required to review the incorporated and unincorporated portions of designated urban growth areas in Spokane County to ensure urban growth areas are sufficient to accommodate the urban growth that is projected to occur between 2011 and 2031. Spokane County has adopted a 2031 population forecast for the County of 612,226. With this forecast, population growth within the urban growth boundary is projected to be 113,541.

Based on the population forecast, the existing urban growth area can accommodate the increase in population and the increased needs for commercial and industrial property. Any increase to the urban growth boundary would likely require a reduction of other areas within the UGA or a revised population forecast to increase the projected 2031 population. Alternative areas were initially developed to better understand the relationship of the natural and built environment of areas adjacent to the existing UGA and to evaluate these areas should there be a need to expand the growth boundary.

The Final Supplemental Environmental Impact Statement (FSEIS) contains responses to the comments on the Draft Supplemental Environmental Impact Statement (DSEIS). The DSEIS is an integrated SEPA /GMA document prepared under WAC 197-11-210. The DSEIS was issued on October 21, 2011 and written Comments were accepted until November 21, 2011. 18 letters of comment were received on the DSEIS. A public hearing on the Urban Growth Area Update is tentatively scheduled for January 26, 2012 at 9:00 a.m. in the Spokane County Board of County Commissioners Hearing Room, 1026 W Broadway Ave, Spokane, WA.

Proposed Action and Alternatives

Spokane County is required to review the incorporated and unincorporated portions of designated urban growth areas in Spokane County to ensure urban growth areas are sufficient to accommodate the urban growth that is projected to occur between 2011 and 2031. Spokane County has adopted a 2031 population forecast for the County of 612,226. With this forecast, population growth within the urban growth boundary is projected to be 113,541.

Based on the population forecast, the existing urban growth area can accommodate the increase in population and the increased needs for commercial and industrial property. Any increase to the urban growth boundary would likely require a reduction of other areas within the UGA or a revised population forecast to increase the projected 2031 population. Alternative areas were initially developed to better understand the relationship of the natural and built environment of areas adjacent to the existing UGA and to evaluate these areas should there be a need to expand the growth boundary.

Reductions to the UGA were considered in development of UGA alternatives. Criteria used to evaluate proposed exclusions included lack of availability of urban services and facilities, barriers to future development, incompatibility of urban development with surrounding uses, environmental factors, land use/development history and property rights considerations. Based on this review one area was identified as a study area for potential removal from the UGA.

The proposed alternatives are described below. The revisions include expansion and/or reduction of the urban growth boundary but do not consider revisions to land use categories within the existing growth boundary. This approach reflects and validates the efforts that each jurisdiction has recently undertaken in their seven year Comprehensive Plan update as required under RCW.70A.130(4). Within this effort the County and Cities within the County updated and reviewed their Comprehensive Plans for consistency with the Growth Management Act.

The alternatives include a range of options. In all, 20 separate study areas are considered and analyzed within the range of alternatives. A more detailed analysis is found in the DSEIS.

Alternative 1 - No Action Alternative

- Retain existing Urban Growth Area boundaries and existing land use categories.
- Alternative 1 has a population capacity within the urban growth area of 117,800 people.
- The expected county-wide population generated from this alternative would be 616,485 which is 4,259 people more than the 2031 forecasted population.

Alternative 2 - Limited Expansion

- Generally retain existing land use categories and densities.
- Consider expansion only in areas that currently have urban development or urban level services.
- Alternative 2 has a population capacity within the urban growth area of 120,721 people.
- The expected county-wide population generated from this alternative would be 619,406 which is 7,180 people more than the 2031 forecasted population.
- Alternative 2 would add 2,494 acres to the UGA including 281 acres of commercial/industrial development.

Alternative 3 - Limited Expansion Plus

- Generally retain existing land use categories and densities.
- Evaluate potential expansion areas focusing on areas that currently have urban development or urban level services and additionally may include some larger areas of vacant land.
- Alternative 3 has a population capacity within the urban growth area of 131,344 people.
- The expected county-wide population generated from this alternative would be 630,029 which is 17,803 more people more than the 2031 forecasted population.
- Alternative 3 would add 4,295 acres to the UGA including 449 acres of commercial/industrial development.

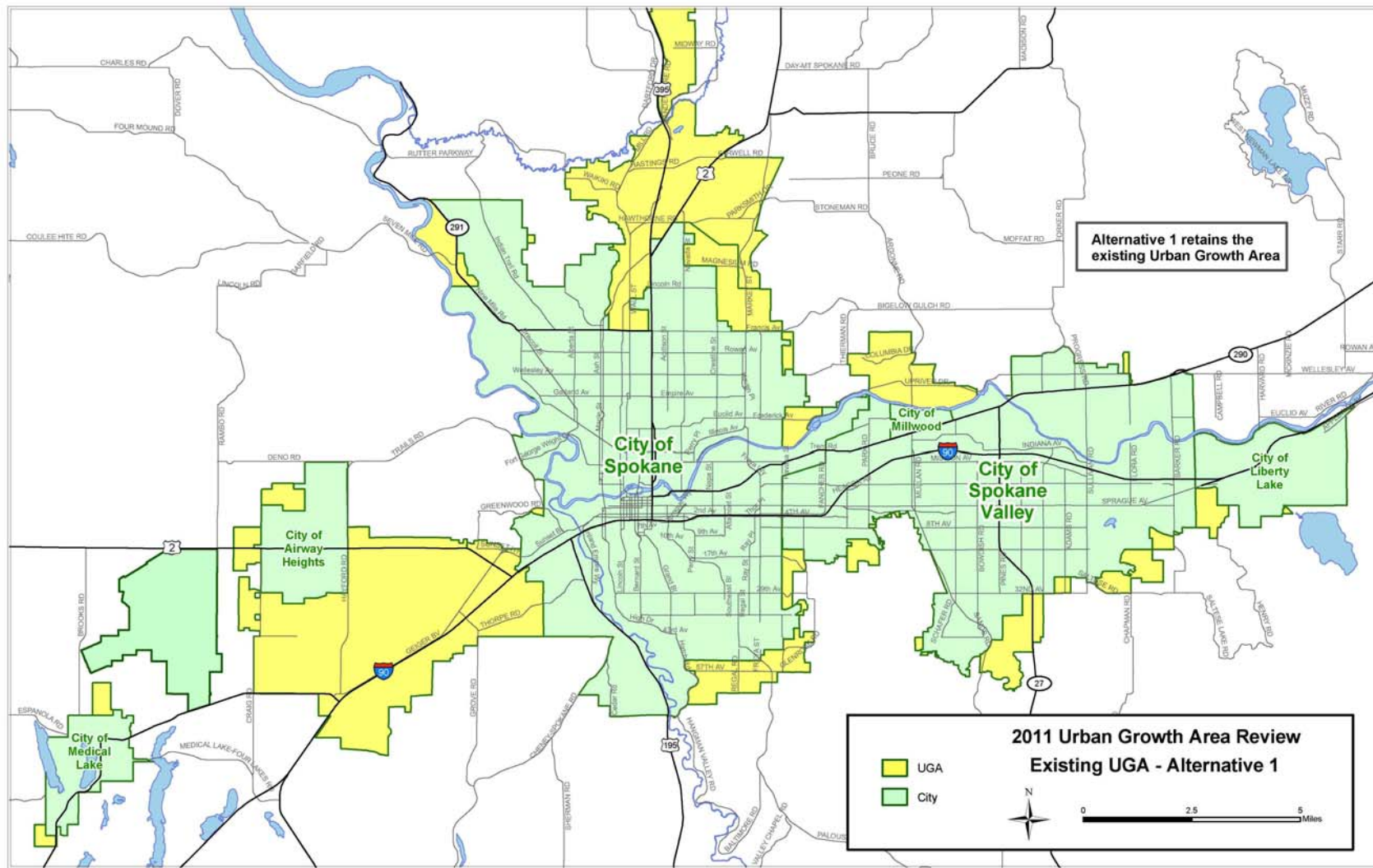
Alternative 4 - Limited Expansion, BoCC

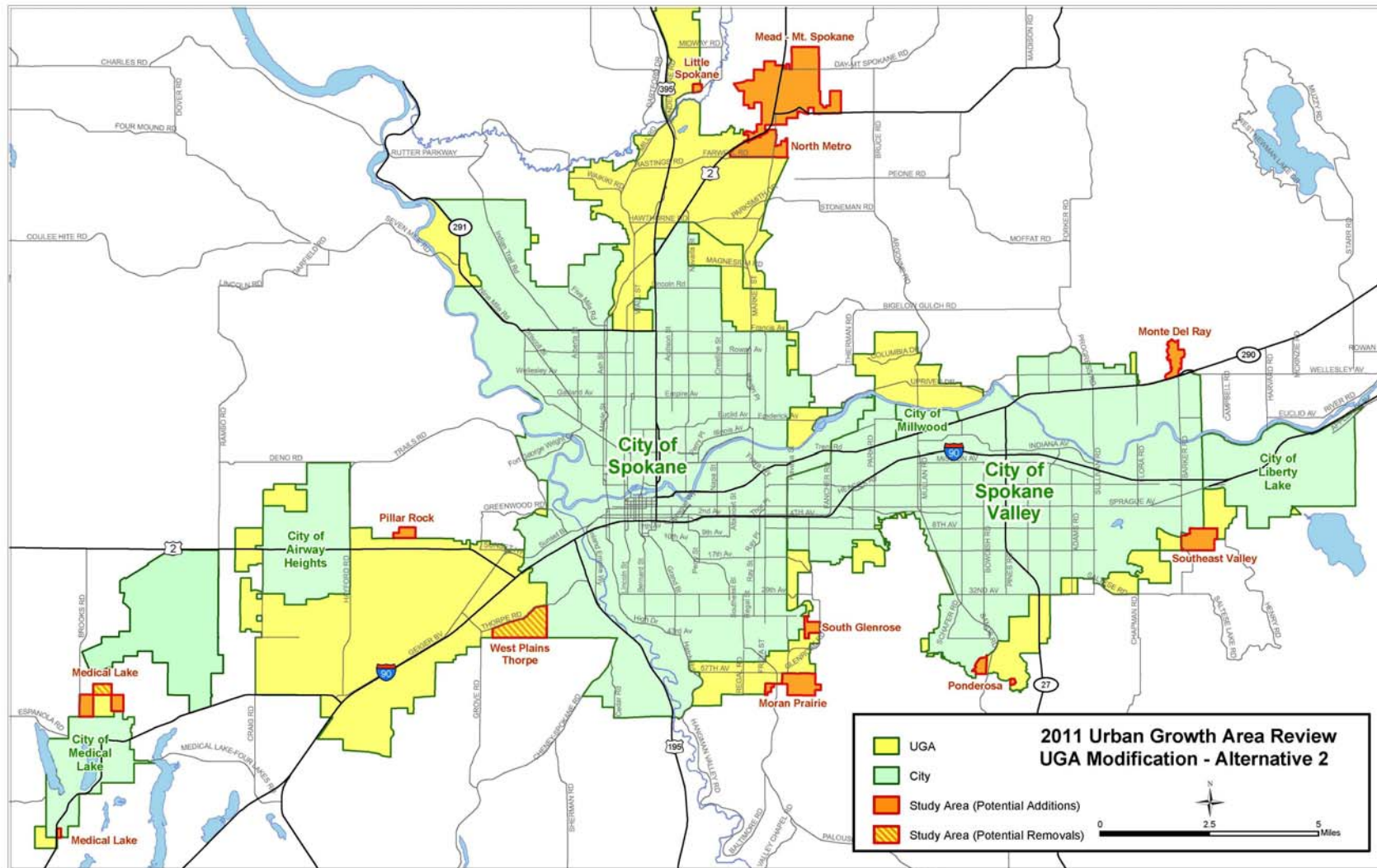
Alternative 4 was developed for consideration by the Spokane County Board of County Commissioners. The alternative includes many of the study areas in the previous alternatives and some additional areas identified by the Board. Additional industrial and commercial areas are considered in this alternative.

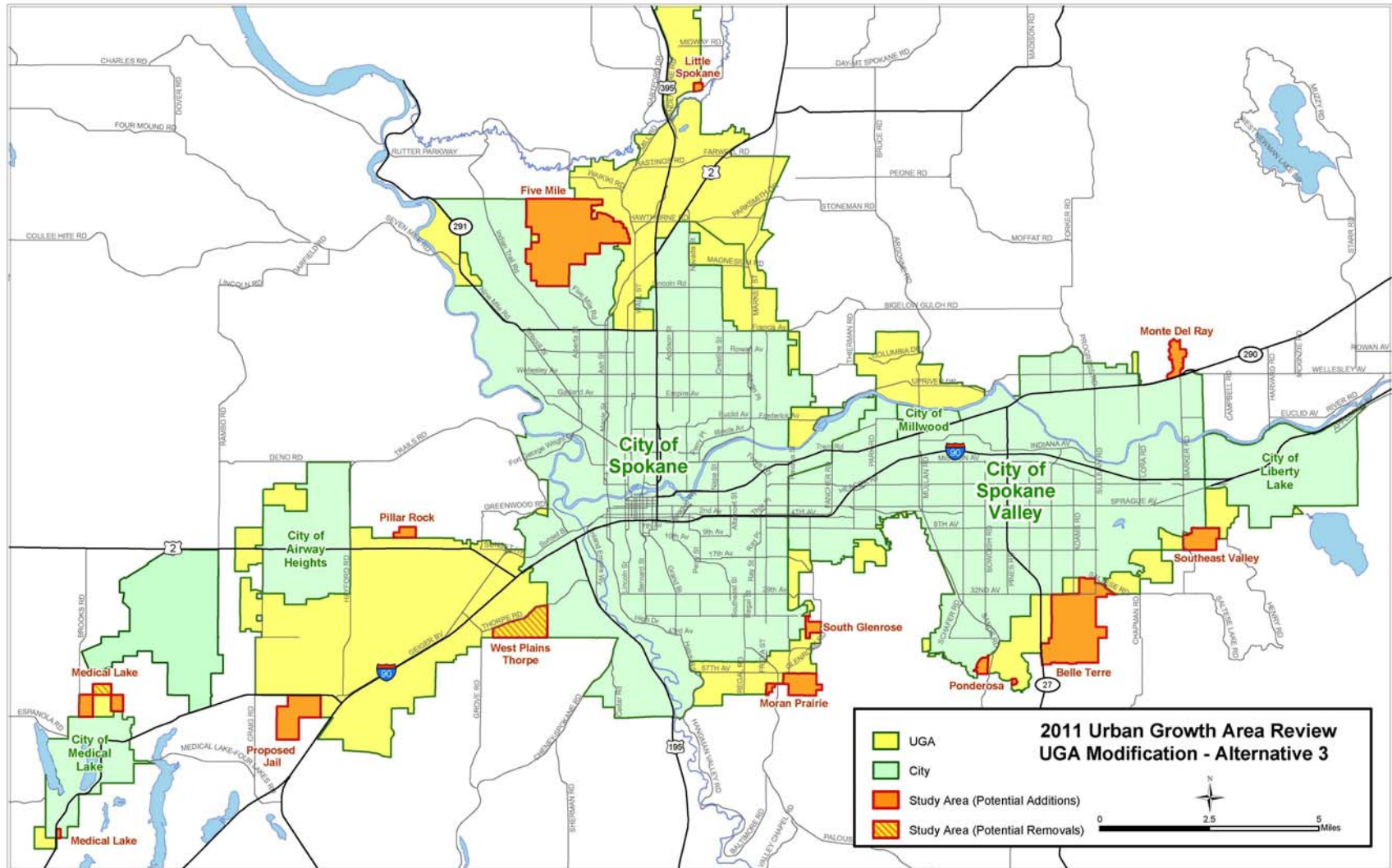
- Alternative 4 has a population capacity within the urban growth area of 122,450 people
- The expected county-wide population generated from this alternative would be 621,108 which is 8,882 more people more than the forecasted population.
- Alternative 4 would add 5,142 acres to the UGA including 2,033 acres of commercial/industrial development.

Right of Way Adjustments Common to all Alternatives

The proposal includes numerous adjustments to urban growth areas that expand the growth area to include adjacent roadways. These amendments will provide consistency in how roadways are related to the urban growth area and will allow the adjacent roadways to be included in cities when they annex. This approach is advocated by the County Engineer and the associated maps are included in Appendix A.







Davenport, Steve

From: Contacts, Web S.
Sent: Thursday, November 10, 2011 6:27 AM
To: Davenport, Steve
Subject: Steve Davenport Contact from Spokane County Public Website

Contact from Spokane County Public Website

Do not reply to this email - this email was sent from the public web server and any reply will be undeliverable. Use the contact information below to respond.

Request

Request date: 11/10/2011 6:27:27 AM
Request type: Comment
Request from: Robin Bekkedahl robin.bekkedahl@avistacorp.com 509-495-8657
Directed to: Steve Davenport

Request text: Thank you for the opportunity to comment on the UGA within Spokane County. Avista wants to request that other utilities, such as electricity, gas, etc are also included in a part of the document also. Avista also purchases land for facilities that is zoned for substations. Many times when an annexation happens the property or surrounding property can get rezoned. We request that there is some accommodation for this situation. Please feel free to contact me if further clarification is needed. My contact information is attached to this request.

Contact details

The following information is for intended for ISD only.

URL: <http://www.spokanecounty.org/ContactUs.aspx?cid=163&d=73>
User Agent: Mozilla/4.0 (compatible; MSIE 8.0; Windows NT 5.1; Trident/4.0; .NET CLR 2.0.50727; .NET CLR 3.0.4506.2152; .NET CLR 3.5.30729; .NET CLR 1.1.4322; InfoPath.2; MS-RTC LM 8)
Browser Capabilities: System.Web.Mobile.MobileCapabilities
User Host Address: 198.181.18.115

Response to Letter 1, Avista
FSEIS, Spokane County Urban Growth Area Update

1. Numerous comments.”

Response

Comments noted. Utilities and service providers have been provided notice and have been encouraged to participate in the urban growth area update. In terms of rezoning of property, Spokane County includes Avista and other utilities in its notification process.

Davenport, Steve

From: Weinand, Kathleen [kweinand@spokanecity.org]
Sent: Monday, August 08, 2011 9:18 AM
To: Davenport, Steve
Cc: Pederson, John
Subject: JLUS Policies relevant to the Geiger Spur

Follow Up Flag: Follow up
Flag Status: Flagged

Steve,

Here are a few polices in the JLUS study that should be addressed in the SEPA analysis for the Geiger Spur Study Area:

A majority of the study area is located in MIA 4 (Land Use Overlay). The description of MIA 4 on 5-19 includes the following language:

Within MIA 4, intensification of land use designations over currently adopted designations (Comprehensive Plan amendments and zone changes) shall not occur without site specific studies defining the appropriateness of the change in relation to the protection of operations at Fairchild AFB.

Policy 25 (page 5-39)

Incorporate Compatibility Planning Concepts in CIPs / Infrastructure Master Plans

Incorporate land use compatibility planning concepts into CIPs / Infrastructure Master Plans for infrastructure extensions and improvements.
 Avoid extension of infrastructure capacity to an area adjacent to the base and currently zoned Rural Traditional.

Policy 48 (page 5-56)

SEPA Documentation Requirements

Local jurisdictions will modify their standard SEPA checklists to ensure potential impacts on Fairchild AFB operations are clearly discussed.

Thank you.

Kathleen Weinand
 City Planner
 Planning Services Department
 City of Spokane
 808 W. Spokane Falls Blvd.
 Spokane, WA 99201-3329
 (509) 625-6146

Response to Letter 2, City of Spokane
FSEIS, Spokane County Urban Growth Area Update

1. Geiger Spur study area within Military Influence Area 4

Response

Comments noted and incorporated in FSEIS.

November 21, 2011

TO: Mr. Steve Davenport, County Planner sdavenport@spokanecounty.org
 City of Spokane Plan Commission path@spokanecity.org tpalmquist@spokanecity.org
 City of Spokane Parks Board jfaught@spokanecity.org
 Palisades Neighborhood palisades99224@gmail.com

FROM: Julia McHugh, Robbi Castleberry, Vic Castleberry, Palisades neighbors & property owners

RE: **Update of County Urban Growth Area – Alternative 4 – Palisades Study Area**

Palisades History

Within the 461 acres under consideration in this alternative, the vast majority of the property is in the public trust as a conservancy area, and most of that in trust to the City of Spokane Parks Department. There is one in-holding belonging to Spokane County. There are a scattering of privately-held parcels, all of which are landlocked. Other than the main north/south park road 'Rimrock Drive', this is a roadless area. Both entrances to Rimrock Drive are signed and gated as a non-motorized recreation area. When viewed in the larger context of the west plains, this is the primary regional park/open space. It has taken shape over time, through the auspices of the Conservation Futures (CF) program.

Through CF, the City and County have strongly and consistently advocated for preservation of unique and irreplaceable lands and habitats. To-date, there has been an investment of public funds exceeding a half-million dollars to purchase land that makes this one-of-a-kind holding possible. In its current configuration, Palisades is a critical section of wildlife corridor, connecting Latah Creek, two cemeteries, and Indian Canyon to Riverside State Park, and beyond. It also hosts a series of scattered wetlands that serve as unique plant and wildlife habitat and also as a groundwater recharge area.

The table below summarizes the Palisades Conservation area history. We urge the County to continue their pursuit of this area as an exceptional regional park, and decline inclusion in the Urban Growth Boundary.

Date	Known As	Acres	Acquisition Cost	Value
1994	Rimrock Conservation Area	8.0	\$75,000	wildlife corridor, non-motorized recreation, plant/animal habitat
2004	Romine	28.6	\$255,500	wildlife corridor, non-motorized recreation, plant/animal habitat
2009	Palisades Addition	1.86	\$10,000	purchase of private in-holding wildlife corridor, non-motorized recreation, plant/animal habitat
2010	Palisades Addition 2	30	\$189,000	wildlife corridor, non-motorized recreation, plant/animal habitat
TOTAL INVESTMENT TO-DATE		68.46	\$529,500	

Current Use

Palisades is in fact a study area. The plant and animal communities of this area have been studied over decades by scout troops, middle to high school students, and by graduate-level university students. It is an outdoor classroom. While recreating, many thousands of people have beheld the views stretching from Latah Creek into Idaho, and to the northwest beyond the Nine-Mile area. While less apparent, Palisades also serves to mitigate poor air quality and high temperatures while functioning as a carbon sequestration mass. As such, it is a piece of the solution to the bigger problem of climate change. Several million dollars could not purchase these diverse functions.

Current Documentation

We find other compelling reasons to decline this area for inclusion into the Urban Growth Boundary:

From *Spokane County's 2011 Urban Growth Area Review*:

- Three Comprehensive Plan Designations and Existing Zoning for this area - Rural Traditional, Rural Conservation, and Rural 5, all indicating the character of this area, which is not conducive to 'low density residential'
- There is zero population capacity in this area, and zero potential residential units
- There is no existing infrastructure in this area

Any change to the UGB is underwritten by the community's ability to provide infrastructure and services. The County has not updated its Capital Services Plan since 2007, and therefore cannot know the cost consequences of this alternative. The costs of installing infrastructure in Palisades, with a predominance of surface and subsurface bedrock, and extreme changes in topography is extremely prohibitive.

If this area were to be included within the UGB, it would raise land values and greatly discourage future CF purchases. This runs contrary to the City and County leadership in this successful program. We encourage a conservative fiscal approach and therefore a rejection of the inclusion of this area in the UGB.

From the *Regional Planning Technical Advisory Committee –*

Regional Land Quantity Analysis for Spokane County, October 2010 Summary Report:

- There is adequate capacity within the current UGA to meet future needs for 20 years – for each of the three capacities cited: residential, commercial, and industrial
- The County's population projection is based on the 2007 - 2027 median population

Population projections should be tempered by what has occurred since 2008, and the drastic curtailing of all types of development. The next forecast is due in 2012, and is expected to reflect downward trends in growth across most sectors, including building. Coupled with adequate capacity to accommodate growth elsewhere in the county, this alternative should be declined for inclusion in the UGB.

From the *City of Spokane Plan Commission November 9, 2011 meeting*:

- Voted 10 to 0 to exclude this area from the UGB based upon:
- It is Rural Conservancy land, containing a park not intended for urban usage, with no plans for a future urban park
- Environmental constraints indicate prohibitive costs to extend urban services
- Spokane City Parks also advised to decline this extension of the UGB – (meeting minutes not yet available)

If the City of Spokane is declining this area as part of its urban reach, we suggest that this wisdom prevail.

*From **Conservation Futures Tenets:***

When property is brought into the public trust, it is held in perpetuity (RCW 84.34). It is not to be sold or altered. The acreage included in this study alternative must be adjusted back to exclude existing CF properties. The west plains area that Palisades serves is considered to be underserved by parks and open space. To jeopardize this area would constitute a severe retreat from the progress realized thus far.

Neighborhood Willingness

The Palisades neighborhood is and has historically been eager to continue working with the County and City and other stakeholders to complete pending acquisitions for properties within the Palisades Conservancy area. The recognized neighborhood association is uncommonly active in working on maintenance and upkeep of this rare open space so that all may benefit. This is an ideal opportunity that other communities can only dream about. Let's work together to complete public ownership in the Palisades area over time, and perfect this area together.

Response to Letter 3, Julia McHugh
FSEIS, Spokane County Urban Growth Area Update

1. Numerous Comments

Response

Comments noted and incorporated in FSEIS.



November 9, 2011

AIRWAY HEIGHTS LIBRARY
1213 S Lundstrom St
Airway Heights WA 99001-9000
509.893.8250

ARGONNE LIBRARY
4322 N Argonne Rd
Spokane WA 99212-1868
509.893.8260

CHENEY LIBRARY
610 First St
Cheney WA 99004-1688
509.893.8280

DEER PARK LIBRARY
208 S Forest Ave | PO Box 729
Deer Park WA 99006-0729
509.893.8300

FAIRFIELD LIBRARY
305 E Main St | PO Box 48
Fairfield WA 99012-0048
509.893.8320

MEDICAL LAKE LIBRARY
321 E Herb St | PO Box 249
Medical Lake WA 99022-0249
509.893.8330

MORAN PRAIRIE LIBRARY
6004 S Regal St
Spokane WA 99223-6949
509.893.8340

NORTH SPOKANE LIBRARY
44 E Hawthorne Rd
Spokane WA 99218-1597
509.893.8350

OTIS ORCHARDS LIBRARY
22324 E Wellesley Ave
Otis Orchards WA 99027-9336
509.893.8390

SPOKANE VALLEY LIBRARY
12004 E Main Ave
Spokane Valley WA 99206-5193
509.893.8400

ADMINISTRATIVE OFFICES
4322 N Argonne Rd
Spokane WA 99212-1868
509.893.8200
FAX 509.893.8472

Steve Davenport
Spokane County Department of Building and Planning
1026 W. Broadway Avenue
Spokane, WA 99260

Re: Urban Growth Area Update Draft Supplemental Environmental Impact Statement

Dear Mr. Davenport:

I'm writing to provide Spokane County Library District's comments on the October 21, 2011 Draft Supplemental Environmental Impact Statement for the Urban Growth Area Update Draft.

1. Although Spokane County Comprehensive Plan CF.1.1 establishes a Level of Service (LOS) of 0.41 SF/capita for library services, there is no discussion or analysis of library service in Section 3.8.2, *Regionally Important Levels of Service*. However, Chapter 4, *Comparative Impact Analysis*, does include the LOS for libraries. I believe there should be a libraries section in 3.8.2.
2. Spokane County Library District's Board of Trustees adopted a 20-year Library Facilities Master Plan (LFMP) on July 20, 2010 that addresses library space needs through 2031 based on OFM's population projections. The LFMP uses an LOS of 0.50 SF/capita, not the 0.41 SF/capita adopted by the Board of County Commissioners, as a planning goal. You might want to consider incorporating this plan. I will email the PDF file.
3. Having reviewed the UGA Update alternatives, it's my opinion that with full implementation of the projects included in the LFMP both the 0.41 SF/capita and the 0.50 SF/capita LOS would be met for each of them.

Please let me know if you have any questions or would like additional information.

Sincerely,

Michael J. Wirt
Executive Director

Response to Letter 4, Mike Writ
FSEIS, Spokane County Urban Growth Area Update

1. Library level of service

Response

Comments noted. Analysis of Spokane County Library level of service is included in Appendix G of the SDEIS as a local level of service for Spokane County.

2. Master Plan and LOS

Response

Comments noted. The library plan is included as Appendix A to the FSEIS. Revising the level of service for library services would require an amendment to the Spokane County Comprehensive Plan.

2. LOS compliance

Response

Comments noted and incorporated in FSEIS.



Spokane County Sheriff's Office
Ozzie D. Knezovich, Sheriff



"In partnership with the community - Dedicated to your safety"

DATE: November 21, 2011

TO: Mr. Steve Davenport
Spokane County Department of Building and Planning

FROM: Lt. Michael Sparber,
Spokane County Sheriff's Department

SUBJECT: 2011 Urban Growth Area Update DSEIS

1 In my review of the Draft Supplemental EIS for the Urban Growth Area Update, I note that two alternatives are presented for the proposed Detention Center site on White Road: Alternative 3 and Alternative 4. I also note that there are 4 alternatives. Thus, my first question: Can either Alternative 3 or Alternative 4 be tied with any of the other alternatives such as 1 or 2. How will the final update boundaries be determined?

2 The site included in Alternatives 3 and 4, was selected through the Essential Public Siting Process that was finalized by the Board of County Commissioners. Spokane County as the host jurisdiction is required to accommodate the selected site alternative, but can apply conditions to mitigate potential impacts.

I also have a couple of specific comments.

Wetlands

3 On table 3.8 Comparative Impacts, under the heading "Wetlands" it states "yes, many in Alternative 3, and "yes" for Alternative 4. Note that wetlands have been delineated on the 40-acres discussed in the EPF. According to the wetlands report, the wetlands identified in the report would not affect the ability to site the proposed project on the site. Regardless of the specific site boundary of the final project, and utility and road alignments, wetlands will be delineated with mitigation if necessary.

Water

Page 4.9, Table 4.5, the matrix shows potential water consumption by the two alternative areas that accommodate the proposed detention facility. It should be noted that the project plans to use City of Spokane water supply by tapping into and extending a main from the city's existing main along Medical Lake Drive.

Sewer

Pages 4.91 and 4.92 regarding Alternative 4.2.14, Large Jail Site, I note that for sewage access, the city sewer main on the southeast side of I-90 is indicated as the possible connection point. We have assumed that the sewer would be extended from the existing city main at Geiger and Thomas-Mallen Road along the north side of I-90. That is what is discussed in the EPF documents, and the environmental checklist for the site. This is also consistent with the city's comments from Eldon Brown. The same is true regarding alternative 4.2.15, Small parcel option on page 4.95.

Transportation,

Travel Time impacts for Alternative 3 is discussed on page 3.38 and for Alternative 4 on page 3.39. The Detention Center project team has had several meetings with WSDOT, Spokane Transit and Spokane County Division of Engineering and Roads to discuss mitigation for the Medical Lake Interchange and the realignment of White Road. These meetings will continue when the project moves into the design phase.

City of Spokane APZ Overlay and Detention Center Site Location.

The 40-acre site that is proposed to accommodate the Spokane County Detention Center was selected from a 500 plus acre parcel under single ownership. Most of the additional property proposed for inclusion into the expanded UGA is under that same ownership. Originally, the preferred site location within this larger parcel was north of the selected site, nearer the Medical Lake Highway. The current location was selected to avoid the Spokane International Airport APZ that was expanded as a result of the runway extension. With the adoption of the city of Spokane's proposed Airport Overlay Zone, the current site is outside the zone 5 area. The zone 5, however, would allow the siting of the proposed facility. Because of that change, the site could be shifted north which, would in turn, reduce the acreage required for the expansion of the UGA. Such a shift, however, would need to be evaluated for wetlands and other site development factors to make sure that the shifted boundary could accommodate the proposed project.

Response to Letter 5, Lt. Michael Sparber
FSEIS, Spokane County Urban Growth Area Update

1. How will final boundaries be determined.

Response

The final boundary will be determined by evaluation of the proposed alternatives and may include a hybrid alternative incorporating different study areas.

2. Essential Public Facility Siting Process

Response

Comments noted.

3. Wetlands and public facility availability

Response

Comments noted.

4. Transportation impacts from proposed prison site

Response

Comments noted.

5. APZ overlay and detention facility location

Response

Comments noted, Spokane County recently amended, through an Interim Official Control, the regulations related to airport compatibility. The new regulations generally match the regulations adopted by the City of Spokane for the West Plains Annexation. Location of the new facility would need to comply with current county development standards.

Merriott, Vickie

From: Davenport, Steve
Sent: Tuesday, November 22, 2011 10:35 AM
To: Merriott, Vickie
Subject: FW: comments on the DSEIS for GMA planning

From: johnnyhumphreys@comcast.net [mailto:johnnyhumphreys@comcast.net]
Sent: Monday, November 21, 2011 11:12 AM
To: Davenport, Steve
Subject: comments on the DSEIS for GMA planning

Steve Davenport

Thank you for the opportunity to comment on the DSEIS for the GMA update.

I live in Bella Vista, at 15112 E Bella Vista Lane, and own some undeveloped property on Belle Terre, both included in Alternative Growth Scenario 3.

I have comments from each perspective.

From the perspective of a homeowner in Bella Vista, I favor Alternative 3 for the good of the County, though it is a neutral to the homeowners. The Bella Vista area is already built out, there are very few lots left. I own one and will not be building it out regardless of GMA status. On the positive side, there would be no new services needed by including the Bella Vista area and there would be significant revenue for usage of the sewage treatment plant. I believe it is always better to get neighborhoods off septic and into sewage treatment that has the capacity.

From the perspective of the owner of the property known as White Tail Ridge, it would be much more important to include this undeveloped property into the GMA whether or not alternative 3 is adapted.

The subject property is a total of 83 acres, with 13 acres having been developed as a cluster development and a remaining 70 acres undeveloped. The reason it would benefit the county to include this area is that it brings balance of housing types to the available developable property. Much of the property inside the GMA in the area off Highway 27 and South of 32nd Ave. has been developed during the last 10 years. The Albertsons store complex, the cemetery, and the apartment complex have used up much of the available property. What remains is medium and high density residential.

My property is most suitable for low density residential and therefore provides balance. It is hilly, treed, and has views appropriate to higher end housing.

In an era where economic stimulation is needed, there needs to be a balance of housing available to attract businesses and companies to our County. This property represents an attractive draw for business owners and managers who would like high end housing close in and with excellent road access such as is provided by Highway 27.

This property is on the border with the GMA, has all services already available on site except sewer. The development is dry lined and ready to connect to sewer. Sewer services are very near on two sides of the property.

I realize that despite the opportunity for favorable impact of sewer connection, there would be some impact for the new development. I am willing to limit that impact by agreement. The impact of the maximum allowed under the low density allowance of six homes per acre would not be indicative of the plan for it's usage. Accordingly I would agree to a density a lot less than six homes per acre under a developer's agreement.

In summary, I suggest Alternative 3 be given serious consideration, but more importantly, that the White Tail Ridge property be included in the GMA for reasons of balance and economic development within the County.

Johnny Humphreys

Response to Letter 6, Johnny Humphreys
FSEIS, Spokane County Urban Growth Area Update

1. Alternative 3 and Whitetail Ridge property.

Response

Comments noted and incorporated in FSEIS.

November 21, 2011

Mr. Steve Davenport, AICP
Department of Building and Planning
1026 W. Broadway Ave.
Spokane, Washington 99260

Dear Mr. Davenport:

Subject: Comments on the Draft Supplemental Environmental Impact Statement for the Urban Growth Area Update (October 21, 2011)
Sent by email to: sdavenport@spokanecounty.org

Thank you for the opportunity to comment on the Draft Supplemental Environmental Impact Statement (Draft SEIS) for the Urban Growth Area (UGA) Update. We appreciate and support that the county is conducting the Growth Management Act (GMA) required ten year urban growth area review and that the county is preparing an environmental impact statement on the UGA update. We appreciate the hard work that county staff, city staff, county elected officials, and city elected officials are devoting to this important project.

Our mission at Futurewise is to promote healthy communities and cities while protecting working farms, working forests, and shorelines for this and future generations. Futurewise has members across Washington State, including many in Spokane County. Our comments follow.

1.3 Proposed Action and Alternatives (Draft SEIS pp. 1.3 – 1.4)

1

We support including a “no action alternative” that retains the county’s existing urban growth areas and land use categories. We also believe that the Final SEIS should include an alternative that reduces the size of the urban growth area so that it matches the land needed to accommodate the county’s projected growth.

Why are Urban Growth Areas Required?

The GMA requires urban growth areas and limits their size for many reasons. **One of the most important is that compact urban growth areas (UGAs) save taxpayers and ratepayers money.** In a study published in a peer reviewed journal, John Carruthers and Gudmaundur Ulfarsson analyzed urban areas throughout the United States including

Spokane County.¹ They found that the per capita costs of most public services declined with density and increased where urban areas were large.²

Urban growth areas encourage housing growth in cities and protect rural and resource lands. To examine the effect of King County, Washington's urban growth areas on the timing of land development, Cunningham looked at real property data, property sales data, and geographic information systems (GIS) data. These records include 500,000 home sales and 163,000 parcels that had the potential to be developed from 1984 through 2001.³ Cunningham concluded that "[t]his paper presents compelling evidence that the enactment of a growth boundary reduced development in designated rural areas and increased construction in urban areas, which suggests that the Growth Management Act is achieving its intended effect of concentrating housing growth."⁴ He also concluded that by removing uncertainty as to the highest and best use of the land that it accelerated housing development in King County.⁵ This study was published in a peer reviewed journal.

Reducing development in rural areas and natural resource lands can also have significant environmental benefits, such protecting water quality and working farms and forests.

One of the most controversial issues related to urban growth areas is whether the restricted land supply causes increases in housing costs. Carruthers, in another peer reviewed study, examined the evidence for the Portland urban growth area and concluded that it was not increasing housing costs because the city's high density zoning allowed the construction of an abundant housing supply.⁶

Urban growth areas help our keep our existing cities and towns vibrant and economically desirable. In a peer reviewed study, Dawkins and Nelson found that Yakima's share of the metropolitan housing market increased after adoption of the GMA.⁷ This and other measures showed that center cities in states with growth management laws attract greater shares of the metropolitan area's housing market than center cities in states without growth management aiding center city revitalization.⁸ This reduces the tendency to move out of existing center cities and for those cities to deteriorate.

¹ John Carruthers and Gudmaundur Ulfarsson, *Urban Sprawl and the Cost of Public Services* 30 ENVIRONMENT AND PLANNING B: PLANNING AND DESIGN 503, 511 (2003). Accessed on Oct. 11, 2011 at: <http://www.mundyassoc.com/publications/urbspra.pdf>

² *Id.* at 518.

³ Christopher R. Cunningham, Growth Controls, Real Options, and Land Development, 89 THE REVIEW OF ECONOMICS AND STATISTICS 343, 343 (2007).

⁴ *Id.* at 356.

⁵ *Id.* at 356 – 57.

⁶ John I. Carruthers, *The Impacts of State Growth Management Programmes: A Comparative Analysis* 39 URBAN STUDIES 1959, 1976 (2002). Carruthers included Washington's GMA in his analysis, but concluded that it was too early to tell if it was successful since it had only been in place for seven years in the data he analyzed, but he believed the GMA had promise if "consistently enforced." *Id.* at 1977.

⁷ Casey J. Dawkins & Arthur C. Nelson, *State Growth Management Programs and Central-City Revitalization*, 69 Journal of the American Planning Association 381, 386 (2003).

⁸ *Id.* at 392 – 93 (2003).

2

Urban growth areas promote healthy lifestyles. Aytur, Rodriguez, Evenson, and Catellier conducted a statistical analysis of leisure and transportation-related physical activity in 63 large metropolitan statistical areas, including Spokane from 1990 to 2002.⁹ Their peer reviewed study found a positive association between residents' leisure time physical activity and walking and bicycling to work and "strong" urban containment policies such as those in Washington State.¹⁰

The Spokane County Urban Growth Areas [UGA] are oversized and so an alternative that right sizes the UGA should be included in the SEIS

The Washington State Supreme Court has held that an "UGA designation cannot exceed the amount of land necessary to accommodate the urban growth projected by [the Washington State Office of Financial Management] OFM, plus a reasonable land market supply factor."¹¹ According to Spokane County's own data, there is no need to expand the urban growth area; in fact it is larger than it needs to be. This conclusion is documented by the *Regional Land Quantity Analysis for Spokane County Summary Report* which concluded that:

3

The County's population projection expects the addition of 113,541 people in the County's UGA between the years 2010 and 2031. The current UGA has the capacity to include 117,800 additional people. This result shows that the increase in population can be accommodated within the current UGA and that there is an additional excess of capacity equaling 4,259 people.¹²

As part of the ten year UGA review the "comprehensive plan must be 'revised to accommodate the urban growth projected to occur in the county for the succeeding twenty-year period.'"¹³ So one of the alternatives considered in the Final SEIS must be an alternative that reduces the size of the UGA so that it complies with the GMA. Since that alternative is legally required, the county should study that alternative. That alternative would also better achieve the benefits of properly sized UGAs documented above.

⁹ Semra A. Aytur, Daniel A. Rodriguez, Kelly R. Evenson, & Diane J. Catellier, *Urban Containment Policies and Physical Activity: A Time-Series Analysis of Metropolitan Areas, 1990-2002* 34 AMERICAN JOURNAL OF PREVENTIVE MEDICINE 320, 325 (2008).

¹⁰ *Id.* at 330.

¹¹ *Thurston County v. Western Washington Growth Management Hearings Bd.*, 164 Wn.2d 329, 351 – 52, 190 P.3d 38, 48 – 49 (2008).

¹² Planning Technical Advisory Committee, *Regional Land Quantity Analysis for Spokane County Summary Report* p. 1 (October, 2010 Amended May, 2011). Accessed on November 21, 2011 at: http://www.spokanecounty.org/data/buildingandplanning/lrp/uga_update/02%20Local%20Jurisdiction%20Land%20Quantity%20Analysis.pdf

¹³ *Thurston County*, 164 Wn.2d 329, 348, 190 P.3d 38, 47.

An alternative that uses a 20 percent market factor should be included in the Final SEIS

In sizing the urban growth area, the county used a 30 percent market factor.¹⁴ Market factors are not required, but the Growth Management Act, allows the county to use a reasonable market factor. What a market factor does is allow a county to make an urban growth area larger than it needs to be. A 30 percent market factor means the land in the urban growth area that can be developed for the new homes is 30 percent larger than necessary to build the needed homes and businesses.

Market factors have been studied in other counties. Snohomish County did survey the owners of vacant land and asked them the relevant question when determining a market factor: if they would develop their land in the next twenty years. Snohomish County hired The Gilmore Research Group to survey owners with developable land. This survey found that “[a]bout 21% of all respondents indicated that they would be unlikely or very unlikely to have their parcels developed in the next 20 years.”¹⁵ “A lower percentage of owners of vacant land (17%) compared to the owners of partially used or redevelopable properties (23%) percent indicated that it would be unlikely or very unlikely that their parcels would be available for development anytime within the next 20 years.”¹⁶ “A lower percentage of owners of parcels designated for multi-family residences, mixed use, or commercial/industrial uses (17%) compared to owners of parcels designated for single family residences (24%) indicated their properties would be unlikely or very unlikely to be available for development over the next 20 years.”¹⁷

This data shows that a reasonable market factor based on real world data is from 17 to 24 percent depending on the mix of vacant and redevelopable land and the mix of commercial land, multi-family land, mixed-use land, and single-family residential land within the urban growth area. We believe that a market factor 20 percent is reasonable and defensible. Futurewise’s April 7, 2010 Scoping Comment Letter recommended that the SEIS include an alternative that used a 20 percent market factor. Since a 20 percent market factor is reasonable we recommend that an alternative that uses a 20 percent market factor should be included in the SEIS. That alternative would also better achieve the benefits of properly sized UGAs documented above.

¹⁴ Planning Technical Advisory Committee, *Regional Land Quantity Analysis for Spokane County Summary Report* p. 7 (October, 2010 Amended May, 2011).

¹⁵ The Gilmore Research Group, *Urban Land Availability Survey of Snohomish County Landowners: Prepared for Jones & Stokes and Snohomish County Planning and Development Services* p. 3 (June 14, 2005). Accessed on November 21, 2011 at: http://www.co.snohomish.wa.us/documents/Departments/PDS/10_Year_Update/Demog/JonesStokesFinalReport6-14-05.pdf

¹⁶ *Id.*

¹⁷ *Id.* at p. 4.

The SEIS should include an analysis of the greenhouse gas (GHG) emissions of the alternatives (3.4.3 Air Quality pp. 3.13 – 3.18)

Futurewise's April 7, 2010 Scoping Comment Letter recommended that the SEIS address the greenhouse gas emissions from the alternatives and whether the alternatives would meet the greenhouse gas emission limits in RCW 70.235.020(1)(a). RCW 70.235.020(1)(a) sets state greenhouse gas emissions limits that require reducing greenhouse gas emissions to no more than the 1990 level by 2020, to reduce emissions to 25 percent below the 1990 level by 2035, and to reduce emissions to 50 percent of the 1990 level by 2050. An analysis of whether the alternatives meet these requirements is required because "[c]limate" is an "element of the environment" under the regulations that implement the State Environmental Policy Act (SEPA).¹⁸

Larger urban growth areas, because they encourage more and longer automobile trips, increase greenhouse gas emissions, such as CO₂. In Washington State, transportation activities are the largest contributor to greenhouse gas emissions, generating 47 percent of our state's global warming causing gases.¹⁹ The Washington Climate Advisory Team (CAT) wrote that we must reduce the amount of driving we do if we are going to meet the state's greenhouse gas emissions requirements (they were goals when the CAT wrote its recommendations):

In order to significantly reduce [transportation] emissions, growth patterns and long-term infrastructure choices that result in compact walkable, bikable and transit friendly communities must be supported, funded and implemented. Cleaner cars and fuels alone will not sufficiently reduce Washington's transportation-related emissions challenge, nor will improved business practices and more efficient energy use alone. Compounding the challenge, most cap-and-trade market mechanisms being considered throughout the world at this time do not directly reduce transportation-related emissions. To put it bluntly, without reductions in vehicle miles traveled (VMT) by single occupancy vehicles, we are unlikely to meet the State's goals for emission reductions. And people will not—in fact, cannot—get out of their cars in sufficient numbers if they do not have viable alternative options for conducting the activities, trips and travels needed and desired for daily life.²⁰

¹⁸ WAC 197-11-444(1)(b)(iii).

¹⁹ Center for Climate Strategies, Washington State Department of Ecology and State of Washington Department of Community, Trade, and Economic Development, *Washington State Greenhouse Gas Inventory and Reference Case Projections, 1990-2020* p. 8 (December 2007), accessed on November 21, 2011 at: http://www.ecy.wa.gov/climatechange/docs/WA_GHGInventoryReferenceCaseProjections_1990-2020.pdf; *Leading the Way: A Comprehensive Approach to Reducing Greenhouse Gases in Washington State Recommendations of the Washington Climate Advisory Team* p. 57 (February 1, 2008), accessed on November 21, 2011 at: <http://www.ecy.wa.gov/pubs/0801008b.pdf>

²⁰ *Leading the Way: A Comprehensive Approach to Reducing Greenhouse Gases in Washington State Recommendations of the Washington Climate Advisory Team* p. 57 (February 1, 2008).

5

So the SEIS should analyze the greenhouse emissions from the alternatives and determine whether they will meet the state greenhouse gas emission reduction requirements. The Washington State Department of Commerce has issued a report that analyzed the best tools to estimate the greenhouse gas emissions of comprehensive plans and amendments entitled *Assessment of Greenhouse Gas Analysis Tools*.²¹ The report analyzed 62 available tools for estimating greenhouse gas emissions related to land use and transportation. The tool evaluation in Appendix B is a useful source of tools for those who want to analyze greenhouse gas emissions from projects or comprehensive plans and amendments.²² In Chapter Four, the report explains how to select the best, and most cost-effective, tool to analyze the greenhouse gases generated by comprehensive plans, transportation plans, and plan amendments. Chapter Three documents the greenhouse gas emission reductions that can be achieved by various land use and transportation measures.

If the analysis of greenhouse gas emissions shows an alternative will not meet the greenhouse gas emission limits in RCW 70.235.020(1)(a), we recommend that mitigation measures be included so that they can meet the reductions from the land use and transportation sectors necessary to meet the state emission reduction requirements.

Section 3.4.4 Water Quality and Stormwater should be revised to better address the impacts of UGA expansions (p. 3.19)

6

The United States Environmental Protection Agency has documented that higher density development with a smaller footprint in a basin will protect water quality when compared to urbanizing larger areas at lower densities within a basin.²³ We documented this impact in our Futurewise's April 7, 2010 Scoping Comment Letter. The SEIS does not include any discussion of these impacts and must to comply with SEPA.

7

The Draft SEIS claims positive impacts from including urbanized areas in the UGA and allowing them to connect to public sewers. However, the GMA allows sewer extensions outside urban growth areas to address threats to the human health and environment if certain conditions are met.²⁴ So the SEIS should disclose that including land in the UGA is not the only way to address failing septic systems.

²¹ Fehr & Peers, EDAW, and AECOM, *Assessment of Greenhouse Gas Analysis Tools* (State of Washington Department of Commerce: December 2009). Accessed on November 21, 2011 at: <http://www.commerce.wa.gov/site/1277/default.aspx> (please click on the "report" link for the full report).

²² Fehr & Peers, EDAW, and AECOM, *Assessment of Greenhouse Gas Analysis Tools* (State of Washington Department of Commerce: December 2009) Appendix B - Table 1 Transportation and Land Use Tools. Accessed on November 21, 2011 at: <http://www.commerce.wa.gov/site/1277/default.aspx> (please click on the "appendices" link).

²³ United States Environmental Protection Agency, *Protecting Water Resources with Higher-Density Development* p. 1 (EPA 231-R-06-001 January 2006). Accessed on November 21, 2011 at: http://www.epa.gov/dced/water_density.htm

²⁴ RCW 36.70A.110(4).

7 Connecting homes currently served by properly functioning septic systems to public sewer systems can also reduce flows to surface water bodies and ground water drinking sources. This can adversely impact those water bodies and supplies of drinking water. This impact from expanding UGAs should be disclosed in the SEIS.

In addition to harming surface water quality, the increased impervious areas associated with urbanization can reduce surface and ground water recharge, especially during the dryer times of the year since water that percolates into soil slowly flows into surface and ground water. Expanding urban growth areas expands this impact and this should be disclosed in the SEIS.

3.4.5 Water Supply and Water Demand should be revised to better address the impacts of the UGA expansions (pp. 3.20 – 3.23)

8 The section on water supply does not mention the impacts of decreased water supplies due to urbanization discussed above. This impact should be discussed and analyzed for the alternatives.

Large lots and low densities increase water demand, increase leakage from water systems, and increase costs to water system customers.²⁵ So accommodating the same population in the existing or a smaller UGA can reduce future water demands and costs.²⁶ This impact should be disclosed and analyzed for each alternative. This is especially important given that some water providers lack adequate supplies to meet future needs as the Draft SEIS does disclose.

3.5.1 Residential Land Quantity Analysis (pp. 3.24 – 3.27)

9 The Draft SEIS on page 3.26 describes a so-called “a safety factor” as being “considered a local methodology option” It is not an option as it is inconsistent with the Supreme Court of Washington’s holding that an “UGA designation cannot exceed the amount of land necessary to accommodate the urban growth projected by OFM, plus a reasonable land market supply factor.”²⁷ The SEIS should clarify this important point.

As we documented above, a 20 percent market factor is adequate for sizing an urban growth area. It also better achieves the many benefits of a compact urban growth area document through this letter. The SEIS discussion of market factors on page 3.25 should disclose these impacts.

²⁵ United States Environmental Protection Agency, *Growing Toward More Efficient Water Use: Linking Development, Infrastructure, and Drinking Water Policies* pp. 3 – 5 (EPA 230-R-06-001: January 2006). Accessed on November 21, 2011 at: http://www.epa.gov/smartgrowth/pdf/growing_water_use_efficiency.pdf

²⁶ *Id.* at p. 8.

²⁷ *Thurston County v. Western Washington Growth Management Hearings Bd.*, 164 Wn.2d 329, 351 – 52, 190 P.3d 38, 48 – 49 (2008).

3.7.1 Spokane Regional Transportation Planning (RCW 47.80.010 - .050) (pp. 3.34 – 3.40)

We support the transportation concurrency analysis in this section. We believe it provides valuable information for decision makers.

However, we have four concerns related to transportation impacts. First, the SEIS states, on page 3.40, that “[a]ny deficiencies resulting from modification to the UGA must include transportation improvements or other strategies to accommodate development within six years.” However, the needed facilities should be identified before the comprehensive plan is amended to expand the UGA, which is why transportation and capital facility elements are required by the GMA.²⁸

Second, expanding the urban growth area expands demand not just for streets and roads, but for facilities for walking, bicycling, horse riding, and transit. There is no discussion of these impacts. The SEIS should address these impacts.

Third, in certain areas there are limited opportunities to evacuate residents in case of fire storms, which is a significant hazard in Spokane County, along with many other counties.²⁹ This impact should be analyzed and disclosed.

Fourth, larger, lower density UGAs increase costs for all of these facilities and their operating and maintenance costs such as snow plowing, transit operations, and periodic street repaving.³⁰ Since the larger UGAs spread future growth over larger areas, densities are likely to be lower. Further, residential development does not pay for the public services they need.³¹ The SEIS should disclose these impacts on the transportation system. It should also include as a mitigating measure updating the transportation and capital facilities plan elements before expanding the urban growth areas.

3.8 Public Services and Utilities (pp. 3.41 – 3.51)

As we documented under transportation, larger, lower density UGAs increase costs for most public facilities and services.³² Since the larger UGAs spread the future growth over larger areas, densities are likely to be lower. Further, residential development does not pay

²⁸ RCW 36.70A.070.

²⁹ *Lanzce G. Douglass, Inc. v. City of Spokane Valley*, 154 Wn. App. 408, 424 – 25, 225 P.3d 448, 456 (2010) review denied by *Lanzce G. Douglass, Inc. v. City of Spokane Valley*, 169 Wn.2d 1014, 236 P.3d 895 (2010).

³⁰ John Carruthers and Gudmaundur Ulfarsson, *Urban Sprawl and the Cost of Public Services* 30 ENVIRONMENT AND PLANNING B: PLANNING AND DESIGN 503, pp. 513 – 17 (2003).

³¹ American Farmland Trust, *Cost of Community Services Skagit County, Washington* p. (1999) “For every dollar of revenue from residential development, \$1.25 was required in [local government] expenditures.” Accessed on November 21, 2011 at:

http://www.farmlandinfo.org/index.cfm?function=article_view&articleID=29972

³² John Carruthers and Gudmaundur Ulfarsson, *Urban Sprawl and the Cost of Public Services* 30 ENVIRONMENT AND PLANNING B: PLANNING AND DESIGN 503, pp. 513 – 17 (2003).

for the public services they need.³³ The SEIS should disclose these impacts on public facilities and services.

14 The SEIS seems to just assume that the needed public facilities and services will be provided, even though the increased residential development will not generate sufficient taxes to pay for all of the public facilities and services it needs.³⁴ The SEIS should include as mitigation measure updates to the capital facilities plan and park and recreation elements to address these needs and their costs. The SEIS should also disclose that rates will likely go up for existing businesses and residents.

3.9 Environmental Summary (pp. 3.51 – 3.53)

The “environmental summary” lists some mitigation measures. The mitigation measures should be expanded to include updates to the transportation, capital facility plan, and recreation elements for the reasons we set out above.

15 Under “Mitigation of Water Rights Issues” on page 3.53 it identifies acquiring water rights as a mitigating measure. Recent water rights acquisitions, such as Spokane County’s recent acquisition, have been from farms and ranches. This increases the likelihood that these lands will be converted to other uses or cease operations, impacting the environment and the county’s economy. These impacts should be disclosed and mitigated. Not expanding the UGA in areas where the providers do not have adequate water rights should also be considered as mitigating measure, especially as we have documented that low density residential development increases demand for water and water leakage losses.³⁵

Chapter 4: Cumulative Impact Analysis

16 We appreciate and support that Chapter 4 seeks to analyze the impacts of the various proposed urban growth area expansion subareas. We agree that the impacts analyzed are helpful to decision makers. This chapter would be strengthened by identifying which expansions would be in areas where fire storm evacuation would be difficult, where the water provider is likely to not have adequate water supplies, and where the expansion would take place on farmland and forest land. For example, the Havana Lyons UGA Study Area and the Southeast Valley Study Area are largely farmland. Other UGA Study Areas, such as the Moran Prairie Study Area, have large areas of farmland. Nowhere in the SEIS are these impacts analyzed or disclosed. This omission violates SEPA since agricultural crops are elements of the environment under the SEPA rules.³⁶

³³ American Farmland Trust, *Cost of Community Services Skagit County, Washington* p. (1999) “For every dollar of revenue from residential development, \$1.25 was required in [local government] expenditures.”

³⁴ *Id.*

³⁵ United States Environmental Protection Agency, *Growing Toward More Efficient Water Use: Linking Development, Infrastructure, and Drinking Water Policies* pp. 3 – 5 (EPA 230-R-06-001: January 2006).

³⁶ WAC 197-11-444(2)(b)(vii).

Chapter 5: Individual Urban Growth Area Requests

17

In contrast with Chapter 4, Chapter 5 includes no analysis of the individual urban growth area requests. So this SEIS does not suffice as the environmental review for these requests. However, given that no expansions can be justified because the UGA is already oversized, the county's decision not to analyze these requests is understandable.

Recommended Mitigation Measures

18

If necessary to meet the state's adopted greenhouse gas emission requirements, we recommend that changes to the land use and transportation elements be considered as potential mitigation measures in the analysis. There is a close connection between the capital facility plan element, the transportation element, the parks and recreation element, and planned growth. We recommend that as part of the 10-Year Urban Growth Area Review, that these elements be updated. In addition, Spokane County was required to update its comprehensive plan and development regulations by December 1, 2006 and has not done so. We recommend a comprehensive update of the county's comprehensive plan and development regulations as a mitigation measure.³⁷

19

Another potential mitigation measure the SEIS should consider is to require an assessment of the human health effects of major policies and development proposals, including UGA expansions. This could help minimize adverse effects on human health and maximize the potential beneficial effects.

20

Thank you for considering our comments. If you require additional information please contact me at telephone number (509) 838-1965 or e-mail Kitty@futurewise.org

Sincerely,

Kitty Klitzke
Eastern Washington Program Director

³⁷ RCW 36.70A.130.

Response to Letter 7, Futurewise
FSEIS, Spokane County Urban Growth Area Update

1. **“...the Final SEIS should include an alternative that reduces the size of the urban growth area so that it matched the land needed to accommodate the county’s projected growth.”**

Response

Comments noted. Removing areas from the UGA should be carefully considered and must provide a balance of the planning goals for reducing sprawl and for protecting property rights from arbitrary and discriminatory actions, as defined under 36.70A.020. The existing UGA was established through previous GMA compliant planning based on the best information available at the time. The UGA was initially adopted in 2001 and subsequently amended on several occasions. These actions followed the GMA process and the resulting comprehensive plan/zoning and UGA designations established reliable expectations for property owners and neighborhoods.

In developing the study areas and alternatives, an analysis was conducted that looked at identifying areas that may be appropriate for removal from the UGA. The analysis considered the GMA planning goals and other factors such as current land use, available infrastructure, compatibility of land uses, planned actions such as preliminary/final plats, and zoning/comp plan history.

The analysis revealed one area, the West Plains/Thorpe study area, which may be appropriate to consider for removal from the current UGA. Removal of the West Plains/Thorpe study area would decrease the population capacity of the UGA by 1,718 people.

The current capacity of Spokane County’s UGA is 117,800 people. The current oversupply of residential capacity within the existing UGA is 4,259 people which equates to approximately 3.8 % of the future population forecasted for the UGA. If the West Plains/Thorpe area is removed the oversupply is reduced to 2,541 people or approximately 2.2 % of the forecasted population. These additional populations are relatively small considering the scale and scope of Spokane County’s urban growth area.

2. **Numerous comments and discussion.**

Response

Comments noted and included within the FSEIS.

3. **The Spokane County Urban Growth Area (UGA) is oversized and so an alternative that right sizes the UGA should be included in the SEIS.**

Response

See comment under number 1.

4. An alternative that uses a 20 percent market factor should be included in the Final SEIS.

Response

The Spokane County Countywide Planning Policies incorporates a specific methodology for land quantity analysis that includes a 30% market factor when calculating residential land capacity. Each jurisdiction is required to be consistent with the CWPPs and must use the adopted methodology.

The Steering Committee of Elected Officials adopted the methodology in 1995 based on recommendations from a Land Quantity Technical Committee composed of elected officials, professional staff and technical/professional experts within the community.

The Countywide Planning Policies provide the framework for GMA planning within Spokane County and may only be revised through an amendment process involving the Steering Committee of Elected Officials and the Board of County Commissioners.

Analysis of the market factor for Spokane County could potentially reveal a lower percentage for market factor; however any changes to the methodology must be incorporated through amendments to the Countywide Planning Policies. Amending the CWPPs would be a separate action outside of the UGA update.

5. The SEIS should include an analysis of the greenhouse gas emissions of the alternatives.

Response

Comments noted and incorporated in the FSEIS.

Greenhouse gases are generated predominantly by the burning of fossil fuels and increases in greenhouse gases are linked to increases in global mean temperature. In our region, greenhouse gasses are predominantly generated from automobile emissions.

A general analysis finds that Alternative 1 provides the most compact development scenario and would produce fewer greenhouse gasses by reducing the total number of automobile trips and providing for more compact, efficient development. Alternatives 2 through 4 progressively increase greenhouse gases by encouraging more and longer automobile trips within larger urban growth areas. Modeling greenhouse gas emissions for each study area or alternative is outside the scope of the SEIS.

Appendix D to the FSEIS includes the report, "*Washington State Greenhouse Gas Inventory and Reference Case Projections, 1990-2020*". The Center for Climate Strategies prepared the report for the Washington State Department of Ecology in December of 2007. The report presents initial estimates of greenhouse gas emissions for the period from 1990 to 2020. The estimates are intended as an initial, comprehensive understanding of current and possible future GHG emissions for Washington, and, thereby inform future analysis and design of GHG mitigation strategies.

Addressing climate change and greenhouse gases in comprehensive plans is not a specific requirement of the Growth Management Act; however, the DSEIS addresses air quality within Chapter 3 which includes analysis of carbon monoxide emissions. Spokane County has adopted a carbon monoxide maintenance plan to monitor and evaluate CO emissions to ensure compliance with Federal Regulations.

RCW 70.235.020, as referenced in the Futurewise letter, directs the State to reduce greenhouse gas emissions and to develop a system for monitoring and reporting emissions of greenhouse gases. RCW 70.235 does not require Counties to illustrate compliance with the reduction requirements of RCW 70.235.

6. Need to document the relationship of development density to water quality.

Response

Comment noted. The United States Environmental Protection Agency document titled, "Protecting Water Resources with Higher-Density Development" is incorporated as Appendix B to the FSEIS.

7. Comments on water quality and stormwater.

Response

Comments noted and included in FSEIS. In response to the comments it should also be noted that areas that have urban services and are built out with urban development will best be served by being included within an urban growth area. RCW 36.70A.110(3) states in part, "Urban growth should be located first in areas already characterized by urban growth that have adequate existing public facility and service capacities to serve such development, second in areas already characterized by urban growth that will be served adequately by a combination of both existing public facilities and services and any additional needed public facilities and services that are provided by either public or private sources, and third in the remaining portions of the urban growth areas." Also it should be noted that unless an area is included in an urban growth area it can not be annexed into a city.

Septic tank and drainfield effects on groundwater

While septic tanks and drainfields may have some role in recharging groundwater, removing septic tanks from over an aquifer may be more important for protecting subsurface water quality. This is especially true in areas of concentrated urban development. Removal of septic tanks in the Spokane Valley has corresponded with decreased nitrate levels, especially around the fringe portions of the aquifer.

8. Comments on water supply and demand.

Response

Comments noted. Water supply and demand has recently undergone a substantial study as reported in the 2011 publication titled, "Spokane County Water Demand Forecast Model." The report is summarized in section 3.4.5 in the SDEIS and is included as SDEIS Appendix 'D'. Additionally the SDEIS analyzes the study areas using the same methodology in the report. The analysis estimates demand for the planning period and provides a comparison of demand to existing water supply and water rights. Mitigation of water demand and water rights issues is discussed on page 3.23 of the SDEIS.

9. Comments on residential land quantity analysis.

Response

The adopted Spokane County Countywide Planning Policies allow for a 30% market factor when calculating land quantity. Response # 4 above discusses the issue of market factor. The CWPPs also allow, as a local option, an additional safety factor for jurisdictions that are unable to monitor their land supply. Spokane County and the cities within the county have not utilized the safety factor in determining land quantity as these jurisdictions have easy access to land monitoring data. Removing the local option safety factor from the Countywide Planning Policies would require an amendment to the Countywide Planning Policies consistent with CWPP amendment procedures. Amending the CWPPs is not within the scope of the UGA update.

10. Comments on regional transportation planning.

Response

Comments noted. Regional transportation modeling by SRTC incorporates transportation improvements that would be expected throughout the planning period. Even considering these improvements, each alternative failed to meet the regionally adopted level of service for corridor travel time. SRTC's analysis of each alternative identified corridors that have the greatest potential for regional transportation deficiencies based on the adopted regional level of service.

Specific improvements or strategies necessary to accommodate development resulting from a UGA expansion are outside of the scope of a regional corridor analysis. Given the adopted regional level of service, expansion of the UGA would require the identification of additional improvements and a financial plan demonstrating the ability to implement the improvements within six years.

Alternatively, the regional level of service can be amended to a lower level which could make additional improvements unnecessary. Amending the level of service would require amending the adopted Concurrency Management System through the Spokane Regional Transportation Council and may require amendment of the Spokane County Countywide Planning Policies through the Steering Committee of Elected Officials and the Board of County Commissioners.

11. Need discussion of facilities for walking, bicycling, horse riding, and transit.

Response

The need for non-auto oriented transportation in expanded UGA areas will increase based on the increase in population in the potential expansion areas. Generally more compact urban areas make non-auto dependent transportation more viable and less expensive. Expanding the UGA will increase the demand for non-motorized facilities over a larger, lower-density area.

Each jurisdiction within the UGA has planning policies and regulations that support bicycle and pedestrian transportation. The Spokane County Countywide Planning Policies has a level of service for transit which is evaluated in Chapter 3 of the SDEIS on page 3.45.

Recent activity related to non-auto oriented transportation includes:

- The complete streets program is being considered in several communities in the UGA.
- The Spokane Valley recently adopted a Bike and Pedestrian Master Plan.
- Spokane County adopted a Regional Trails Plan in 2008.
- The City of Spokane is currently developing a Pedestrian Plan
- SRTC and SRHD recently completed a Regional Pedestrian Plan
- SRTC recently completed a Regional Bike Plan
- The Conservation Futures Program provides access to trails throughout the County.
- Spokane County recently adopted connectivity standards for subdivisions to make neighborhoods more bike and pedestrian friendly.

12. Addressing fire hazard risks of development.

Response

Fire protection is provided by a variety of development standards. These standards include requirements for roadway widths, turnarounds, multiple access points, fire flow, hydrant spacing and other engineering and design standards. SEPA review of individual development proposals is also available to mitigate any additional impacts that may be identified in the design of a specific proposal within the UGA.

Spokane County adopted a Community Wildfire Protection Plan in November, 2008. The Plan was the result of analyses, professional cooperation and collaboration, assessments of wildfire risks and other factors considered with the intent to reduce the potential for wildfires to threaten people, structures, infrastructure, and unique ecosystems.

Additionally, the DSEIS was circulated to all fire districts in Spokane County for comment on fire concerns within the UGA or proposed study areas.

13. General comments, Impacts to transportation system, facilities planning.

Response

Comments noted and incorporated in FSEIS. Transportation impacts are evaluated through the regional level of service adopted by the Steering Committee of Elected Officials and the Board of County Commissioners. This evaluation is included in Chapter 3 of the DSEIS. Capital projects and funding sources for transportation are included in the 6 year Transportation Improvement Program and the 20 year Metropolitan Transportation Plan (MPT). Spokane County's 6 year Transportation Improvement Program and Sewer Construction Capital Improvement Program are included in this FSEIS as Attachment 'C'. The 20 year MTP and each jurisdictions capital facility plan is included as supporting documents in the DSEIS.

14. Public service and utilities.

Response

See response under 13 above. Additionally a fiscal and capital cost analysis is included in Chapter 4 of the DSEIS on pages 4.13 and 4.14. Public services and

utilities are also evaluated through the regional level of service analysis in Chapter 3 of the SDEIS, pages 3.41 through 3.51. Additionally each jurisdiction has analyzed their local levels of service and those reports are included in Appendix G of the DSEIS. Local jurisdiction capital facility plans are also referenced as supporting documents within the SDEIS.

15. Public service and utilities.

Response

Comments noted and incorporated in the FSEIS. Also see response under 8 above.

16. Cumulative impacts.

Response

Comments noted. See response 12 above regarding fire hazard issues. In terms of farmland, none of the study areas includes resource land that have been designated as agricultural land of long term commercial significance or forestry land. Most of the study areas are within the urban reserve or rural categories. Small scale agricultural uses are included in some of the study areas. Land use is identified and discussed in the summary of each study area.

17. Individual Urban Growth Area Requests.

Response

Comment noted.

18. Greenhouse gas.

Response

See response # 5 above.

19. Comprehensive Plan Update not completed.

Response

Spokane County updated its Comprehensive Plan and Zoning Code in compliance with GMA requirements under RCW 36.70A.130(4). See Board of County Commissioner's Resolution 2007-0208. The next update of the County's Comprehensive Plan is not required until 2017.

20. Assess human health effects.

Response

Comment noted. This type of evaluation could be useful and informative but was not included within the scope of study.

Merriott, Vickie

From: Davenport, Steve
Sent: Tuesday, November 22, 2011 10:36 AM
To: Merriott, Vickie
Subject: FW: 2011 UGA

-----Original Message-----

From: Lorna St John [<mailto:lorna@hamiltonstudio.com>]
Sent: Monday, November 21, 2011 3:58 PM
To: Davenport, Steve
Subject: 2011 UGA

Dear Mr. Davenport,

Kitty Klitzke was kind enough to forward the Futurewise statement concerning proposed changes to the Urban Growth Area to me.

It is hard to imagine that should I spend hours and hours I could come up with a more reasoned and thorough analysis.

So I wish to say ditto to the profound argument Futurewise made. So let that text by my testimony as well.

I found a couple areas particularly egregious. It will not surprise anyone that the proposal by Steve Smart to leap frog to Bigelow Gulch Road is one of them.

The other is a treasure in our county that should be preserved and held at all costs against encroachment; that is the Palisades area.

May I just say also, that we have certainly not used up all the growth potential inside the current boundaries. It's not like there aren't enough sites for homes and businesses already. So, I agree that the growth area should be scaled back as Ms Klitzke points out. There is more at stake than instant revenue. The quality of the county is at stake as well.

Lorna St. John
7208 E. Bigelow Gulch Road
Spokane, WA 99217

Lorna St John
lorna@hamiltonstudio.com
Hamilton Studio
509 327-9501

Response to Letter 8, Lorna St. John
FSEIS, Spokane County Urban Growth Area Update

1. Numerous Comments.

Response

Comments noted and incorporated in FSEIS.

November 21, 2011

Mr. Steve Davenport, AICP
Spokane County
Department of Building and Planning
1026 W. Broadway
Spokane, WA 99260

RE: Draft EIS for Urban Growth Area Update

Thank you for allowing my comments on the draft EIS.

Referencing 1.3 and 1.4 – I certainly support a no action alternative. I believe the UGA we now have is far greater than we actually need. Since it is important that UGA's retain their "compact" urban areas which not only provide concurrency in services but also protect rural areas. Perhaps we should think about an alternate proposal that shrinks the UGA totally to make the actual projections for Spokane County.

Referencing 3.43, 3.13 -3.18 – In reading through the Washington Climate Advisory Team projections for greenhouse gas emissions in larger UGA areas, it is clear we need to reduce our emissions and one way to do that is to provide for a complete streets concept, where more people can bike, walk and drive shorter distances to work or play. We must meet State goals and we cannot do that without viable alternatives.

Referencing 3.24 – 3.27 – The draft EIS in discussing the residential land quantity analysis refers to a local methodology option "safety factor". This absolutely should not be considered as an option. The Washington Supreme Court ruled that a UGA cannot exceed the amount of land necessary to accommodate the growth number projection from the OFM including the a reasonable market supply factor. A reasonable market factor is 20% but could be as low as 17%.

Referencing 3.40 – Five Mile is very well aware of the value of concurrency. Therefore, all transportation facilities should be identified within the capital facilities plan **before** the expansion of the UGA, not afterwards and not within 6 years. And please let's not forget that GMA/Comprehensive Plan puts pedestrians first. I see no mention of transportation facilities pedestrians or bicycling in the EIS.

Please remember that cumulative impacts are extremely important. Given that no expansion can be justified because the UGA is already oversized, it is even more critical that when you are selecting certain study areas that all the possible cumulative impacts are utilized on the study area but also on adjacent parcels.

Respectfully

Kathy Miotke
Five Mile Neighborhood Association
3309 W. Lincoln Rd.
Spokane, WA 99208

Response to Letter 9, Kathy Miotke
FSEIS, Spokane County Urban Growth Area Update

1. Supports No Action Alternative

Response

Comments noted.

2. Climate Change.

Response

Please see response number 5 to letter number 7.

3. Use a 20% market factor.

Response

Please see response number 4 to letter number 7.

4. Capital Facilities and Concurrency.

Response

Please see response number 11, 13 and 14 to letter number 7.

5. Cumulative Impacts.

Response

Comment noted. See Chapter 4 of the SDEIS for analysis of cumulative impacts.

PARSONS/BURNETT/BJORDAHL/HUME^{L.L.P.}

ATTORNEYS

Stacy A. Bjordahl
sbjordahl@pblaw.biz

November 21, 2011

Steve Davenport
Spokane County Division of Building and Planning
1026 W. Broadway Ave.
Spokane, WA 99260

***Re: Comments on Draft Environmental Impact Statement
Urban Growth Area Update***

Dear Steve:

Thank you for the opportunity to comment on the Draft Environmental Impact Statement for the Urban Growth Area Update. These comments are intended to supplement the analysis for Individual UGA Request # 16 (Kunze Farms-Comprehensive Plan Amendment No. 10-CPA-05). This is a request to re-designate approximately 40 acres of property from Urban Reserve to Low Density Residential. The subject property is located east of Thomas Mallen Road and South of Hallett Road, in the West Plains area of Spokane County.

I. PROJECT SCOPE

Taylor Engineering has prepared a conceptual platting layout which complies with the Spokane County Zoning Code for Low Density Residential. Based upon site conditions, requirements for street extensions, stormwater management, etc, Taylor Engineering has determined that the subject property could support a development of approximately 137 single family lots¹.

A. Adequate Public Facilities Are Available to Serve Future Development of the Property.

Based upon such conceptual plat, Taylor Engineering performed a feasibility analysis to determine if there are adequate public facilities and utilities available to support development of the property. In summary, utilities necessary to serve the subject property are either adjacent to or near the site. This includes water, sewer, gas, and electricity. All necessary infrastructure including water, sewer, streets, and utilities will be installed by the developer at its sole expense. In addition, at time of development, the applicant will fund and mitigate any additional infrastructure or improvements that are

¹ A copy of the Taylor Engineering Report is included in File No. 10-CPA-05.

determined to be necessary when the project is evaluated under the County's Concurrency Ordinance, SEPA, and the Subdivision Ordinance.

B. Transportation Infrastructure is Adequate to Serve Future Development of the Property.

Based upon the conceptual plat designed by Taylor Engineering, Whipple Consulting Engineers completed a Planning Level Trip Generation and Distribution Analysis for the subject property. Based upon the potential number of trips to be generated by development of the subject property, Whipple Consulting Engineers has determined that a change of the property from Urban Reserve to Low Density Residential will not create a negative impact upon the existing transportation system². As noted above, at time of development, the applicant will fund and mitigate any additional infrastructure or improvements that are determined to be necessary when the project is evaluated under the County's Concurrency Ordinance, Standards for Road and Sewer Construction, SEPA, and the Subdivision Ordinance.

II. URBAN LEVEL OF SERVICE IMPACT ANALYSIS

As part of the Urban Growth Area update review, Spokane County has identified four "Study Areas" and completed an urban level of service/assumption and summary of impacts for each Study Area. Applying the same methodology for the Kunze Farms Investments property, the following is a summary of the impacts that could be created by the inclusion of Kunze property into the UGA.

Level of Service/Assumption

Law Enforcement	1.01 officers per 1,000 people
Libraries	.41 square feet per capita
Parks	1.4 acres of park per 1,000 people
Schools	.5 students per residential unit
Transportation	10 trips per day residential unit
Wastewater	200 gallons per day per residence
Water Consumption	230 gallons per day per residence

² A copy of the Whipple Engineering Report is included in File No. 10-CPA-05.

Impacts to Urban Levels of Service for Kunze Farms Investments Property

Population Growth	342 people [2.5 per residence]
Law Enforcement	.3 officers
Libraries	140 square feet
Parks	.5 acres
Schools	68 students
Transportation	1,390 trips per day [Whipple Engineering Study]
Wastewater	27,400 gallons per day
Water Consumption	31,510 gallons per day

Based upon the above level of service assumptions, inclusion of the Kunze Farms property into the UGA will not create any significant impact on public services or infrastructure. The total population allocation to this property is only 342 people and will have a negligible impact on law enforcement, libraries and schools. With respect to parks, future development of the subject property can include a "pocket park" of one-half acre to mitigate any impacts. As noted in the report prepared by Whipple Consulting Engineers, a change of the property from Urban Reserve to Low Density Residential will not create a negative impact upon the existing transportation system. Based upon the feasibility analysis prepared by Taylor Engineering, there are adequate public facilities and infrastructure available either on or near the subject property. All necessary infrastructure and improvements will be solely funded by the developer. Finally, with respect to schools, there have been no comments from the Cheney School District; therefore, it is assumed that the District could handle the additional 68 students that future development of this property could potentially generate.

III. SUMMARY

Based upon the above and the additional supporting documents contained in the project file, Kunze Farms Investments Co. Inc. respectfully requests that the property be included into the Urban Growth Area boundary and redesignated from Urban Reserve to Low Density Residential.

If you have any questions regarding this matter, please contact me. Thank you for your courtesies.

Sincerely,

PARSONS/BURNETT/BJORDAHL/HUME, LLP

By 
Stacy A. Bjordahl

Response to Letter 10, Stacy Bjordahl
FSEIS, Spokane County Urban Growth Area Update

1. Site specific request for UGA inclusion

Response

Letter 10 provides additional information for individual UGA request # 17 which is one of the individual requests included in Chapter 5 of the DSEIS. It should be noted that environmental analysis was not conducted for individual requests unless they were included within one of the study areas identified in the SDEIS. Letter #10 provides applicant generated analysis of project scope and urban level of impacts.

This proposal was also considered as an annual comprehensive plan amendment (10-CPA-05) in the 2010 and 2011 annual amendment cycles. The project file for 10-CPA-05 includes a staff report, SEPA checklist and a Determination of Nonsignificance for the proposal.

November 21, 2011

TO: Mr. Steve Davenport, County Planner sdavenport@spokanecounty.org
 City of Spokane Plan Commission path@spokanecity.org tpalmquist@spokanecity.org
 City of Spokane Parks Board jfaught@spokanecity.org
 Palisades Neighborhood palisades99224@gmail.com

FROM: Julia McHugh, Robbi Castleberry, Vic Castleberry, Palisades neighbors & property owners

RE: **Update of County Urban Growth Area – Alternative 4 – Palisades Study Area**

Palisades History

Within the 461 acres under consideration in this alternative, the vast majority of the property is in the public trust as a conservancy area, and most of that in trust to the City of Spokane Parks Department. There is one in-holding belonging to Spokane County. There are a scattering of privately-held parcels, all of which are landlocked. Other than the main north/south park road 'Rimrock Drive', this is a roadless area. Both entrances to Rimrock Drive are signed and gated as a non-motorized recreation area. When viewed in the larger context of the west plains, this is the primary regional park/open space. It has taken shape over time, through the auspices of the Conservation Futures (CF) program.

Through CF, the City and County have strongly and consistently advocated for preservation of unique and irreplaceable lands and habitats. To-date, there has been an investment of public funds exceeding a half-million dollars to purchase land that makes this one-of-a-kind holding possible. In its current configuration, Palisades is a critical section of wildlife corridor, connecting Latah Creek, two cemeteries, and Indian Canyon to Riverside State Park, and beyond. It also hosts a series of scattered wetlands that serve as unique plant and wildlife habitat and also as a groundwater recharge area.

The table below summarizes the Palisades Conservation area history. We urge the County to continue their pursuit of this area as an exceptional regional park, and decline inclusion in the Urban Growth Boundary.

Date	Known As	Acres	Acquisition Cost	Value
1994	Rimrock Conservation Area	8.0	\$75,000	wildlife corridor, non-motorized recreation, plant/animal habitat
2004	Romine	28.6	\$255,500	wildlife corridor, non-motorized recreation, plant/animal habitat
2009	Palisades Addition	1.86	\$10,000	purchase of private in-holding wildlife corridor, non-motorized recreation, plant/animal habitat
2010	Palisades Addition 2	30	\$189,000	wildlife corridor, non-motorized recreation, plant/animal habitat
TOTAL INVESTMENT TO-DATE		68.46	\$529,500	

Current Use

Palisades is in fact a study area. The plant and animal communities of this area have been studied over decades by scout troops, middle to high school students, and by graduate-level university students. It is an outdoor classroom. While recreating, many thousands of people have beheld the views stretching from Latah Creek into Idaho, and to the northwest beyond the Nine-Mile area. While less apparent, Palisades also serves to mitigate poor air quality and high temperatures while functioning as a carbon sequestration mass. As such, it is a piece of the solution to the bigger problem of climate change. Several million dollars could not purchase these diverse functions.

Current Documentation

We find other compelling reasons to decline this area for inclusion into the Urban Growth Boundary:

From *Spokane County's 2011 Urban Growth Area Review*:

- Three Comprehensive Plan Designations and Existing Zoning for this area - Rural Traditional, Rural Conservation, and Rural 5, all indicating the character of this area, which is not conducive to 'low density residential'
- There is zero population capacity in this area, and zero potential residential units
- There is no existing infrastructure in this area

Any change to the UGB is underwritten by the community's ability to provide infrastructure and services. The County has not updated its Capital Services Plan since 2007, and therefore cannot know the cost consequences of this alternative. The costs of installing infrastructure in Palisades, with a predominance of surface and subsurface bedrock, and extreme changes in topography is extremely prohibitive.

If this area were to be included within the UGB, it would raise land values and greatly discourage future CF purchases. This runs contrary to the City and County leadership in this successful program. We encourage a conservative fiscal approach and therefore a rejection of the inclusion of this area in the UGB.

From the *Regional Planning Technical Advisory Committee –*

Regional Land Quantity Analysis for Spokane County, October 2010 Summary Report:

- There is adequate capacity within the current UGA to meet future needs for 20 years – for each of the three capacities cited: residential, commercial, and industrial
- The County's population projection is based on the 2007 - 2027 median population

Population projections should be tempered by what has occurred since 2008, and the drastic curtailing of all types of development. The next forecast is due in 2012, and is expected to reflect downward trends in growth across most sectors, including building. Coupled with adequate capacity to accommodate growth elsewhere in the county, this alternative should be declined for inclusion in the UGB.

From the *City of Spokane Plan Commission November 9, 2011 meeting*:

- Voted 10 to 0 to exclude this area from the UGB based upon:
- It is Rural Conservancy land, containing a park not intended for urban usage, with no plans for a future urban park
- Environmental constraints indicate prohibitive costs to extend urban services
- Spokane City Parks also advised to decline this extension of the UGB – (meeting minutes not yet available)

If the City of Spokane is declining this area as part of its urban reach, we suggest that this wisdom prevail.

*From **Conservation Futures Tenets:***

When property is brought into the public trust, it is held in perpetuity (RCW 84.34). It is not to be sold or altered. The acreage included in this study alternative must be adjusted back to exclude existing CF properties. The west plains area that Palisades serves is considered to be underserved by parks and open space. To jeopardize this area would constitute a severe retreat from the progress realized thus far.

Neighborhood Willingness

The Palisades neighborhood is and has historically been eager to continue working with the County and City and other stakeholders to complete pending acquisitions for properties within the Palisades Conservancy area. The recognized neighborhood association is uncommonly active in working on maintenance and upkeep of this rare open space so that all may benefit. This is an ideal opportunity that other communities can only dream about. Let's work together to complete public ownership in the Palisades area over time, and perfect this area together.

Response to Letter 11, Robbi Castleberry
FSEIS, Spokane County Urban Growth Area Update

1. Numerous Comments

Response

Comments noted and incorporated in FSEIS.

Merriott, Vickie

From: Davenport, Steve
Sent: Tuesday, November 22, 2011 10:34 AM
To: Merriott, Vickie
Subject: FW: Steve Davenport Contact from Spokane County Public Website

From: Contacts, Web S.
Sent: Monday, November 21, 2011 2:57 AM
To: Davenport, Steve
Subject: Steve Davenport Contact from Spokane County Public Website

Contact from Spokane County Public Website

Do not reply to this email - this email was sent from the public web server and any reply will be undeliverable. Use the contact information below to respond.

Request

Request date: 11/21/2011 2:56:35 AM
Request type: Comment
Request from: Blaine L. and Marcella L. Bennett marcellabennett@hotmail.com 509-467-7422
Directed to: Steve Davenport
Request text: We have great concern regarding the proposed re-zoning (11-CPA-05) as Five Mile Road is a sub-standard roadway not capable of serving an area evolving into an urban development. This is the access road to connect to middle and high schools that serve hundreds of students. Their safety must be a primary consideration. We urge you to deny this application until safety standards can be met. Thank you.

Contact details

The following information is for intended for ISD only.

URL: <http://www.spokanecounty.org/ContactUs.aspx?cid=163&d=73>
User Agent: Mozilla/5.0 (Windows NT 5.1; rv:8.0) Gecko/20100101 Firefox/8.0
Browser Capabilities: System.Web.Mobile.MobileCapabilities
User Host Address: 75.165.180.243

Response to Letter 12, L. Blaine
FSEIS, Spokane County Urban Growth Area Update

1. Five Mile Road concerns

Response

Comments noted and incorporated in FSEIS. Comment also forwarded to annual comprehensive plan amendment file 11-CPA-05.



PLANNING SERVICES
808 W. SPOKANE FALLS BLVD.
SPOKANE, WASHINGTON 99201-3329
509.625.6060
FAX 509.625.6013
Spokaneplanning.org

November 21, 2011

John Pederson
Spokane County Planning Director
1026 W. Broadway Avenue
Spokane, WA 99260

Dear Mr. Pederson,

Thank you for the opportunity to comment on the draft Supplemental Environmental Impact Statement (DSEIS) for the review of Spokane County's Urban Growth Area (UGA) update.

The City of Spokane requests that the DSEIS include a section discussing the possible impacts of adding residential population capacity and areas that would increase industrial and commercial areas to the UGA before the population forecast warrants the additional geography. Expansion of the UGA before it is warranted may lead to decreased densities and higher public services and utility costs.


The DSEIS evaluates the alternatives assuming a build-out of the additional areas and does not take into account the effects of adding the study areas before they are needed or timely. While this approach may be necessary for some analysis, such as traffic modeling, it does not address the possibility that adding more land to the Urban Growth Area (UGA) may result in having the same population or amount of development spread out over a larger area and at lower densities.

For example Table 4.2 shows the population capacity of each alternative then shows how many police officers, square feet of libraries facilities, etc. would be needed based on the population capacity and adopted level of service. It needs to be acknowledged that all of the alternatives have the same assumed 20 year population growth.

The impacts and costs of having public services and utilities serving lower density development patterns needs to be addressed.

Again, thank you for the opportunity to comment. The City of Spokane looks forward to continuing to work with Spokane County to complete this update effort.

Sincerely,



Scott Chesney
Planning Director, AICP
City of Spokane

Response to Letter 13, City of Spokane
FSEIS, Spokane County Urban Growth Area Update

1. Impacts of UGA expansions

Response

This issue of land capacity and its relationship to population and commercial/industrial land demand is discussed in the Environmental Summary, Section 3.9.2 on page 3.51. Additionally Chapter 4 provides detailed analysis of impacts of the various alternatives. Comparison of service/facility impacts is found on page 4.3. A fiscal and capital cost comparison of the alternatives is found on page 4.14. A regional level of service evaluation is found on page 3.41 which evaluates level of service standards in comparison to the population forecast and alternatives.

2. Effect of adding study areas

Response

Comments noted and incorporated in the FSEIS. Determining capacity and impacts for each study area is an important tool for comparing and evaluating the study areas and alternatives. A more generalized discussion of sprawl vs. concentrated development patterns is included in the prior environmental documents including the 1996 EIS and the 2000 SEIS. The Environmental Summary, Section 3.9.2 on page 3.51 clarifies that the land quantity analysis does not support expansion of the UGA since adequate capacity is currently available to support future growth.

Merriott, Vickie

From: Davenport, Steve
Sent: Tuesday, November 22, 2011 10:35 AM
To: Merriott, Vickie
Subject: FW: UGA seis

From: Mallory Atkinson [<mailto:matkinson@SRTC.ORG>]
Sent: Monday, November 21, 2011 10:58 AM
To: Davenport, Steve
Subject: UGA seis

Hi Steve,

I have neglected to forward on a couple of comments I received from the City of Spokane on the transportation section of the SEIS. Could you please include and/or address these comments? Thanks!

- The City requested that it be noted that the transportation analysis assumed that if a UGA was added, there would be full build out in the UGA by 2030. This would result in a higher population in Spokane County than we are currently projecting. In reality, expanding the UGA will not result in a higher population, but will spread the population out over a larger area. The result will be a decreased population density in Spokane County.
- The City also questioned why the alternatives were compared against Alternative 1 rather than the established travel time thresholds.

Since it is the County's document now – for the second point, would you like to include an explanation in the text as to why Alt 1 was used as the comparison alternative rather than the thresholds? Let me know if you'd like me to draft something up.

Thanks!!

Mallory Atkinson
Transportation Planner
Spokane Regional Transportation Council
221 W. First Avenue, Suite 310
Spokane, WA 99201-3613
Office: (509) 343-5251
Fax: (509) 343-6400

Response to Letter 14, SRTC
FSEIS, Spokane County Urban Growth Area Update

1. Impacts of UGA expansions

Response

Comment noted and incorporated in FSEIS. See response to Letter 13.

2. Transportation, comparison of alternatives.

Response

Travel times in the proposed alternatives were compared to travel time thresholds established by SRTC pursuant to the Countywide Planning Policies. In each alternative, including the no-change alternative (Alternative 1), numerous corridors do not meet the established travel time thresholds. In order to provide decision makers and the public with more comparative information, each alternative in this document is analyzed as compared to the no-change alternative.

Merriott, Vickie

From: Davenport, Steve
Sent: Tuesday, November 22, 2011 10:34 AM
To: Merriott, Vickie
Subject: FW: UGA Zone reclassifications
Attachments: Scan0008.pdf; Scan0009.pdf; Scan0010.pdf; Scan0011.pdf; Scan0012.pdf; Scan0013.pdf

From: gdruddell@charter.net [mailto:gdruddell@charter.net]
Sent: Tuesday, November 15, 2011 6:38 PM
To: Davenport, Steve; Danny Ruddell; Cathy Sturman
Subject: UGA Zone reclassifications

Mr. Steve Davenport, Senior Planner
Spokane County Building & Planning

Mr. Davenport:

Please find attached a request for inclusion in the 2012 UGA. The letter is written on behalf of Daniel & Joann Ruddell, who own properties off South Barker Road. I have also mailed a hardcopy of all attachments and the 2005 application for inclusion for your review.

Please do not hesitate to contact me, should you have questions or require additional information to complete the request for inclusion. Our family would anxiously accept an invitation to a hearing and any follow-up to this application.

Respectfully George Ruddell

Mr. Steve Davenport, Senior Planner
Spokane County Building & Planning
1026 West Broadway Avenue
Spokane, WA 99260

RE: 2011-2031 Urban Growth Area Zone Reclassifications

Mr. Davenport:

This letter is written on behalf of Daniel and Joann Ruddell who own approximately 77 acres of property off of South Barker Road. (Tax Parcels No. 55301.9055 and .9056) Through this letter, the Ruddell family wishes to request the subject properties are reclassified and included in the Spokane County Urban Growth Area (UGA) for 2012.

A request for inclusion in the Spokane County UGA was originally submitted on June 29, 2005 and these properties are presently zoned Urban Reserve (attachment). The properties, vested for urban development, are presently bordered on the North, West and South by UGA properties. Those developments include Turtle Rock to the North, Twin Bridges to the North East, and Morning Star on the South and West.

Since the 2005 application, significant utility services were added and changes have occurred which we feel are noteworthy of consideration for inclusion into the UGA. These include:

1. Sewer Utilities; a functioning sewer line bisects the properties diagonally. (noted)
2. Water Utilities; domestic water service is located on the property through construction of a water reservoir owned by Consolidated Irrigation District. (noted)
3. Transportation; the Chapman Road extension bisects diagonally through these properties. The Ruddell's granted an easement and road development and grading has begun. County Road Project # 08006423. (noted)
4. Property; the Ruddell family purchased back 34 acres of adjacent property from Valley Christian School in 2009. (parcel .9056) Both properties (Parcels .9055 and .9056) are vested for development. Ref. RCW 36.70A.110

The Ruddell family looks forward to your careful review and favorable recommendation for inclusion into the UGA. Should you have any question or require additional information, please do not hesitate to contact me.

Sincerely, George Ruddell
290 21st St. N.E.
E. Wenatchee, WA 98802
Ph. 509-884-2368

E-Mail: gdruddell@charter.net

Notice of Application

The Spokane County Department of Building and Planning (Review Authority) has published this Notice of Application to provide the opportunity to comment on the described proposal. The comment period ends 14 calendar days from the date issued. During this period written comments may be submitted to the Review Authority. The file may be examined between the hours of 7:30 a.m. and 4:00 p.m. Monday through Friday (except holidays) at the Department of Building and Planning in the Public Works Building, 1026 W. Broadway, Spokane, Washington. Questions may be directed to the Project Coordinator listed below or Spokane County Engineers - Matt Zarecor.

PROJECT #: 08006423

OWNER: SUMMIT PROPERTY DEVELOPMENT
CONTACT: SUMMIT PROPERTY DEVELOPMENT

PHONE: 509-928-5777

PHONE: 509-590-8383

APPLICATION DATE: 03-NOV-08

DETERMINATION OF COMPLETENESS: 11/04/08

SITE ADDRESS: 17800 E CHAPMAN RD

LOCATION: 17800 BLOCK OF EAST CHAPMAN RD 55302.2611; 55305.9002; 55194.9076; 55301.9088, .9056, .9055

PARCEL #: 55302.2611; 55305.9002; 55194.9076; 55301.9088, .9056, .9055

PROJECT: GRADING 70,000 CU YD FOR FUTURE CHAPMAN ROAD EXTENSION

ZONING: LDR

OTHER PERMITS: PE-1998-07; approval of engineering road design for Chapman Road Extension & approach permit

FURTHER STUDIES:

ENVIRONMENTAL REVIEW: The Department of Building and Planning & Engineers has reviewed the proposed project for probable adverse environmental impacts and expects to issue a determination of nonsignificance (DNS) for this project. The optional DNS process in WAC 197-11-355 is being used. This may be the only opportunity to comment on the environmental impacts of the proposed project. The proposal may include mitigation measures under applicable codes, and the project review process may incorporate or require mitigation measures regardless of whether an EIS is prepared. A copy of subsequent threshold determination for the specific proposal may be obtained upon request. The Spokane Environmental Ordinance governs any SEPA appeal and such appeal shall be filed within fourteen (14) days after the notice that the determination has been made.

EXISTING ENVIRONMENTAL DOCUMENTS: The requirements of this road is in conjunction with PE -1962-05 Morningside Heights 5th Add, Morningside Heights 6th Add, Morningside Heights 7th Add, Brigadoon Add & PE -1998-07 preliminary plat of Belleaire. Environmental Checklist for Belleaire is running concurrently with this Environmental Checklist.

WRITTEN COMMENTS: Agencies, tribes and the public are encouraged to review and provide written comments on the proposed project and its probable environmental impacts. All comments received within 14 calendar days of the date issued below will be considered prior to making a decision on this application.

DEVELOPMENT REGULATIONS: Spokane County Zoning Code, Spokane County Subdivision Ordinance, Spokane County Standards for Roads and Sewer Construction, Spokane County Guidelines for Stormwater Management, Spokane County Critical Area Ordinance and the regulations of the Spokane Regional Health District are the primary regulations applicable to the site.

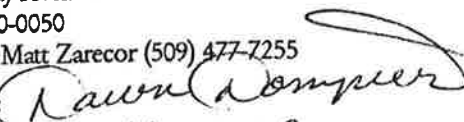
CONSISTENCY: In consideration of the above referenced development regulations and typical conditions and/or mitigating measures, the proposal is found to be consistent with the "type of land use", "level of development",

PUBLIC HEARING: This action is not subject to a future public hearing.

REVIEW AUTHORITY: DAWN DOMPIER, Project Coordinator & MATT ZARECOR, County Engineers & Roads
 Mark Holman, Assistant Director
 Spokane County Division of
 1026 West Broadway Avenue
 Spokane, WA 99260-0050
 (509) 477-3675 or Matt Zarecor (509) 477-7255

Date Issued: 11-6-08

Signature:



The comment period closes at 4:00 p.m. on

11-21-08

[illegible]

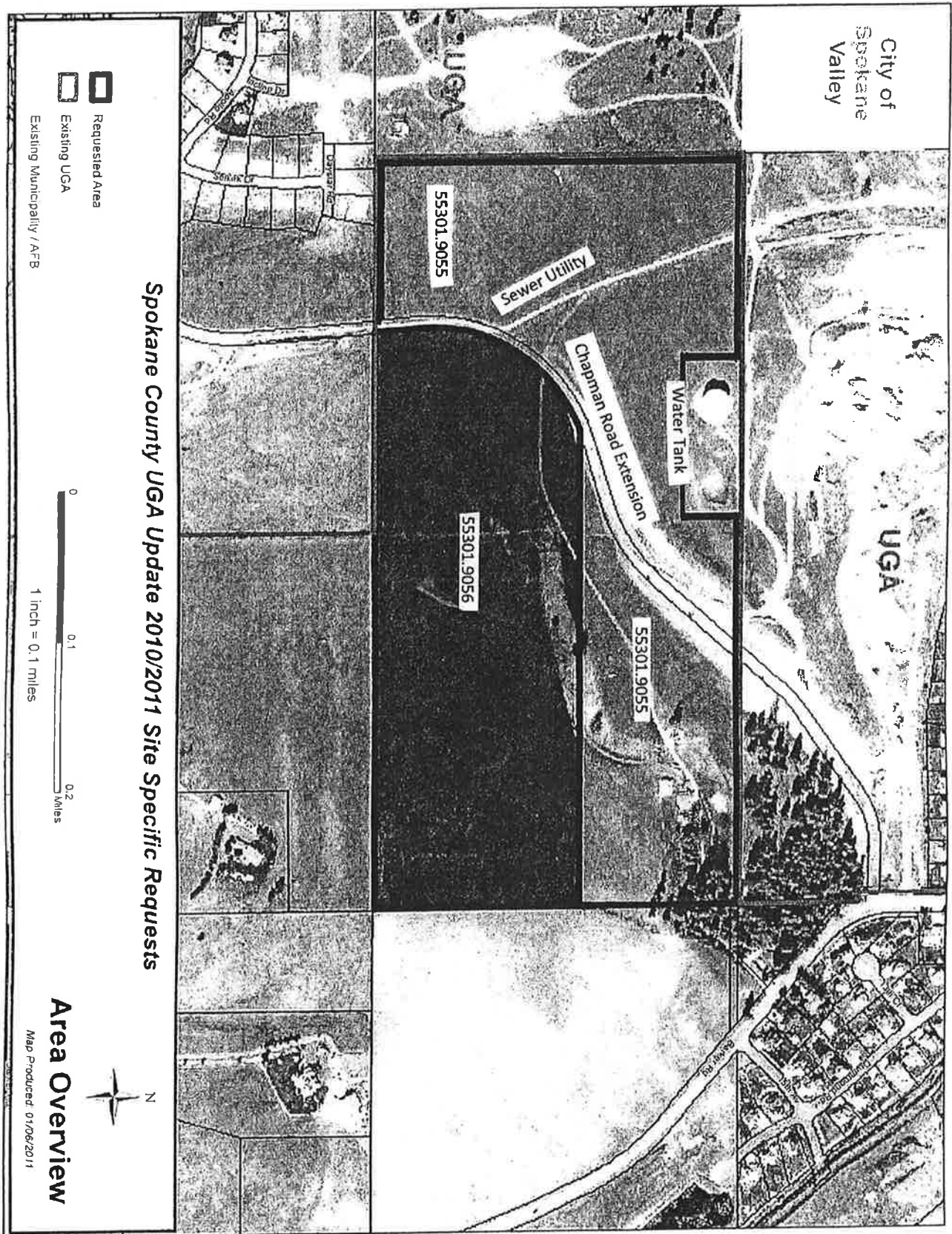
Comprehensive Plan

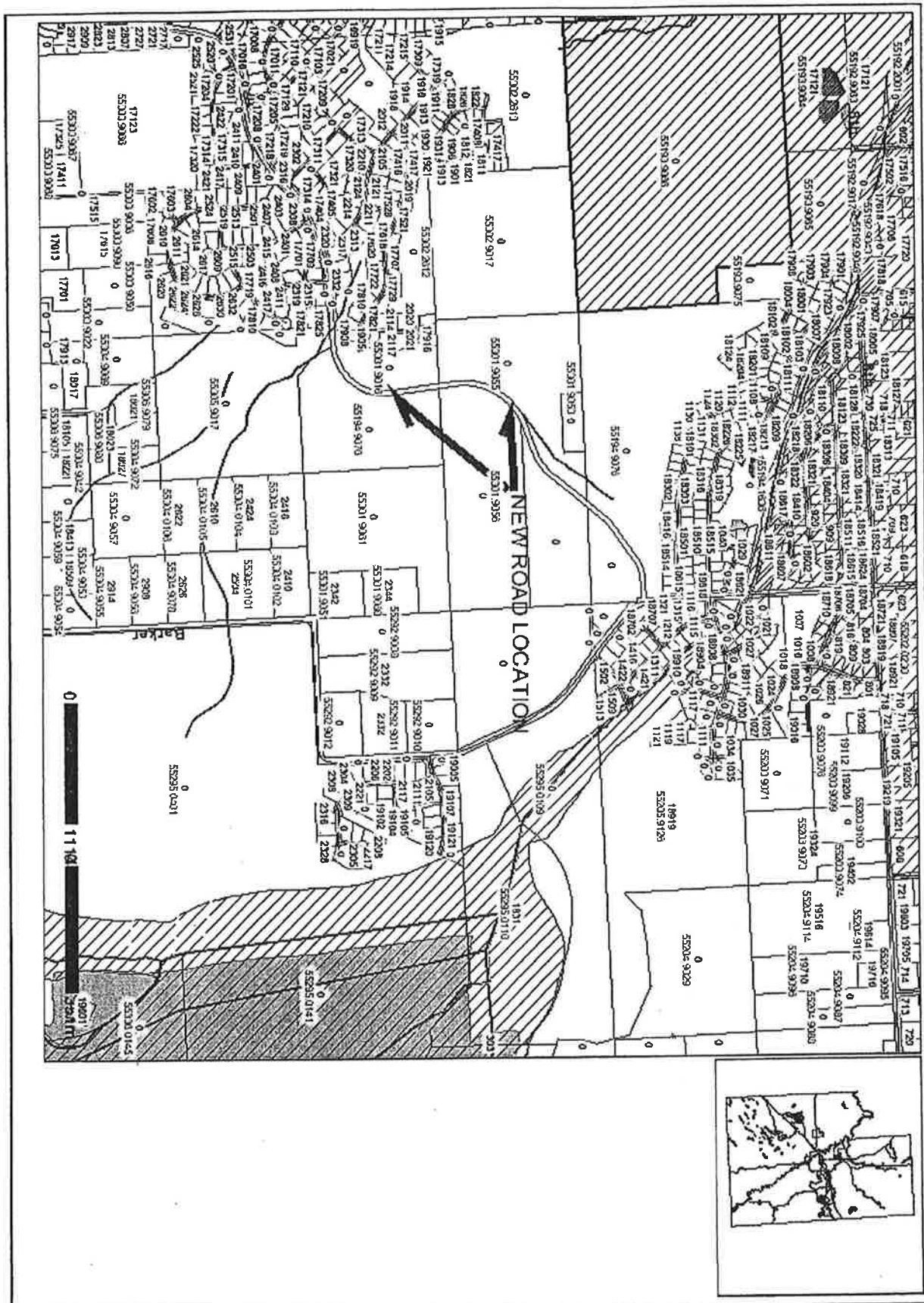
SPokane Valley Christian School
 35501 N. 35th St.
 Spokane, WA 99218

LEGEND

1. LOT 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 8

USKH Department of Defense Planning and Logistics 1000 North 17th Street, Suite 100 Arlington, VA 22209-4144 Tel: 703-681-1000 Fax: 703-681-1001 E-mail: uskh@doe.mil Web: www.uskh.mil		1000 N. 17th St., Ste. 100 Arlington, VA 22209-4144 Tel: 703-681-1000 Fax: 703-681-1001 E-mail: uskh@doe.mil Web: www.uskh.mil
Project Name: PRELIMINARY LOT LAYOUT EXHIBIT MAP		Project No: 1 OF 1





Response to Letter 15, George Ruddell
FSEIS, Spokane County Urban Growth Area Update

1. Impacts of UGA expansions

Response

This letter is a site specific request to include property within the UGA and is referenced in the DSEIS in Chapter 5 as letter 14 in the 2010/11 requests and as letter 48 in the 2005 requests. It should be noted that environmental analysis was not conducted for individual requests unless they were included within one of the study areas identified in the SDEIS.



**Washington State
Department of Transportation**
Paula J. Hammond, P.E.
Secretary of Transportation

Eastern Region
2714 N. Mayfair Street
Spokane, WA 99207-2050
509-324-6000
Fax 509-324-6005
TTY 1-800-833-6388
www.wsdot.wa.gov

November 21, 2011

Mr. John Pederson
Spokane County Building and Planning
1026 W. Broadway Ave.
Spokane, WA 99260

Re: Urban Growth Area Update

Dear Mr. Pederson;

Thank you for the opportunity to review the Draft Supplemental Environmental Impact Statement (DSEIS) for the Urban Area Update. Following a review of this document, the Washington State Department of Transportation (WSDOT) requests the address of the following comments:

Section 3.7.2

Alternatives 2 & 4 include expansion of the Urban Growth Areas Expansion (UGA) for the Mead/Mt. Spokane Metro Area. These alternatives are expected to add 641 new housing units and 736 new employees. This increase in housing and employment will have an effect on the transportation system which needs to be evaluated.

Alternative 3 & 4 include an expansion of the Urban Growth Area (UGA) for the Proposed Jail Site and Geiger Spur. These alternatives are expected to add 3,256 employees in alternative 3 and 11, 524 employees in alternative 4. This is a very significant increase in employment that may require substantial improvements to the regional transportation system in order to accommodate the projected growth. A more detailed evaluation of the alternatives is needed.

Section 3.7.3

In this section, the increase in travel time for the three alternatives was only evaluated on select corridors. Of particular interest to WSDOT are the I-90, US 2, and SR-902 corridors. We have included comments concerning each of these corridors below:

I-90

In all three alternatives the travel time on I-90 increases between 14% and 17%. This is concerning as the corridor selected is from the Lincoln County line to the Idaho State Line, which results in an overly broad corridor which tends to mask the more direct impacts of this proposal. The identified corridor should be shortened to specially evaluate the alternatives on I-90 from Four Lakes to Freya St.

Mr. Pederson
November 21, 2011
Page 2

US 2

Alternative 4 shows an 8% increase in travel time on this corridor which is significant considering the limits of the corridor. Again this corridor is defined very broadly as being the Lincoln County line to the Pend Oreille County line. The limits of this corridor should be adjusted to more clearly match the areas being considered for development. US 2 West should be adjusted to include the area from Fairchild AFB to I-90 and US 2 North from the Division Street Wye to Colbert Road.

SR 902

While this route is not a Highway of Statewide Significance it still needs to be evaluated for impacts associated with the Jail and Geiger Spur sites, as it will be directly affected by these developments. The SR 902 corridor should be evaluated between Craig Rd. and I-90 for the proposed alternatives.

Summary

We also concur with the summary of the transportation section which states:

"SRTC's transportation review of the proposed alternative modifications to the existing UGA indicates that any unmitigated change to the existing UGA may have detrimental impacts on travel time performance of the regional transportation system. Any deficiencies resulting from modification to the UGA must include transportation improvements or other strategies to accommodate development within six years."

Consequently, we ask that these probable impacts be evaluated and quantified in the Final Supplemental Environmental Impact Statement.

Thank you for the opportunity to comment on this document and look forward to the continued coordination on this process. If you should have any questions or concerns regarding this matter please do not hesitate to contact me at 324-6199.

Sincerely,



Greg Figg
Transportation Planner

cc: Ray Wright, City of Spokane
Scott Engelhard, Spokane County Engineers
Charlene Kay, WSDOT Planning
Project File

Response to Letter 16, WSDOT
FSEIS, Spokane County Urban Growth Area Update

1. Transportation Comments

Response

SRTC reviewed and responded to the comments as follows:

Section 3.7.2

Each alternative was evaluated for travel time impacts to the regional transportation system, as dictated by the Concurrency Management System. A more detailed evaluation of the localized impacts of individual study areas is outside the scope of the SEIS.

Section 3.7.3

I 90 & US 2 – SRTC concurs that the length of some CMS corridors may mask localized variation in delay. However, the corridors and their terminis are the adopted standards for evaluating regional transportation concurrency (see Spokane County Concurrency Management System).

SR 902 – SR 902 from Medical Lake Rd IC to Salnave Rd IC was evaluated as part of SRTC's travel time analysis. The travel times on this corridor did not exceed Alternative 1 by greater than 5% (margin of error). In regards to evaluating the section of SR 902 between Craig Rd and I 90, a more detailed evaluation of the localized impacts of individual study areas is outside the scope of the SEIS.

Summary

The alternatives were evaluated for travel time impacts to the regional transportation system, as dictated by the Concurrency Management System. A more detailed evaluation of the localized impacts of individual study areas is outside the scope of the SEIS.

Merriott, Vickie

From: Davenport, Steve
Sent: Tuesday, November 22, 2011 10:36 AM
To: Merriott, Vickie
Subject: FW: WDFW comments Draft SEIS
Attachments: WDFWComments_DraftSEIS_UGARReview.doc

From: Divens, Karin A (DFW) [<mailto:Karin.Divens@dfw.wa.gov>]
Sent: Monday, November 21, 2011 2:44 PM
To: Davenport, Steve
Subject: WDFW comments Draft SEIS

See attached. In the interest of time, I focused on PHS/critical areas issues.

Thanks,

[Karin A. Divens](#)

Priority Habitats and Species Biologist/Area Habitat Biologist
Washington Dept. of Fish and Wildlife
2315 N Discovery Place Spokane Valley, WA 99216
(509) 892-1001 x 323 karin.divens@dfw.wa.gov

PHS on the Web: <http://wdfw.wa.gov/mapping/phs/>



STATE OF WASHINGTON
DEPARTMENT OF FISH AND WILDLIFE

2315 N Discovery Place • Spokane Valley, Washington 99216-1566 • (509) 892-1001 FAX (509) 921-2440

November 15, 2011

Spokane County Building and Planning
Attn: Steve Davenport
1026 W Broadway Avenue
Spokane, WA 99260

SUBJECT: WDFW Comments on Spokane County Draft Supplemental Environmental Impact Statement (DSEIS)

Dear Mr. Davenport:

The Washington Department of Fish and Wildlife (WDFW) has received the draft SEIS and would like to provide the following comments for consideration:

During review of the Draft SEIS, WDFW observed that Spokane County used older PHS data to analyze the areas. WDFW conducts a comprehensive update of PHS data every 3 years. Spokane County was last updated this year, with the previous update in 2008. In addition, WDFW conducted a comprehensive update to the Statewide PHS list in 2008. At this time, amongst other updates, the following changes were made: Riparian habitat is no longer mapped in PHS but stands on the definition:

The area adjacent to flowing or standing freshwater aquatic systems. Riparian habitat encompasses the area beginning at the ordinary high water mark and extends to that portion of the terrestrial landscape that is influenced by, or that directly influences, the aquatic ecosystem. In riparian systems, the vegetation, water tables, soils, microclimate, and wildlife inhabitants of terrestrial ecosystems are often influenced by perennial or intermittent water. Simultaneously, adjacent vegetation, nutrient and sediment loading, terrestrial wildlife, as well as organic and inorganic debris influence the biological and physical properties of the aquatic ecosystem. Riparian habitat includes the entire extent of the floodplain and riparian areas of wetlands that are directly connected to stream courses or other freshwater.;

Urban Natural Open Space and Rural Natural Open Space were eliminated as categories in PHS. Instead, these areas were either taken out of PHS due to land use pressures, or converted to either the Riparian category or to Biodiversity Areas and Corridors:

Biodiversity areas and corridors are areas of habitat that are relatively important to various species of native fish and wildlife.

1. Biodiversity areas

a. The area has been identified as biologically diverse through a scientifically based assessment conducted over a landscape scale (e.g., ecoregion, county- or city-wide, watershed, etc.).

Examples include but are not limited to WDFW Local Habitat Assessments, Pierce County Biodiversity Network, and Spokane County's Wildlife Corridors and Landscape Linkages.

OR

b. The area is within a city or an urban growth area (UGA) and contains habitat that is valuable to fish or wildlife and is mostly comprised of native vegetation. Relative to other vegetated areas in the same city or UGA, the mapped area is vertically diverse (e.g., multiple canopy layers, snags, or downed wood), horizontally diverse (e.g., contains a mosaic of native habitats), or supports a diverse community of species as identified by a qualified professional who has a degree in biology or closely related field and professional experience related to the habitats or species occurring in the biodiversity area. These areas may have more limited wildlife functions than other priority habitat areas due to the general nature and constraints of these sites in that they are often isolated or surrounded by highly urbanized lands.

2. Corridors

Corridors are areas of relatively undisturbed and unbroken tracts of vegetation that connect fish and wildlife habitat conservation areas, priority habitats, areas identified as biologically diverse (see attribute 1a), or valuable habitats within a city or UGA (see attribute 1b).

I understand that Spokane County recently requested a new set of PHS data from WDFW Headquarters. I will be sure to keep the County in the loop for when the next set of updates is occurring.

Alternatives Analysis:

No Action Alternative:

WDFW supports the No Action Alternative as the preferred alternative. This alternative does not result in an expansion of Priority Habitats and Species impacts and accommodates projected population capacities.

Alternative 2

WDFW has a number of PHS concerns with specific annexation proposals with the options of Alternative 2 but could support Alternative 2 if PHS and critical areas could be avoided. PHS maps and the text from each polygon where WDFW has concerns are included below:

Mead-Mt. Spokane and North Metro:

The biggest concern with the proposed annexation of these areas is the resulting pinch point to an area that is mapped priority habitat for moose.

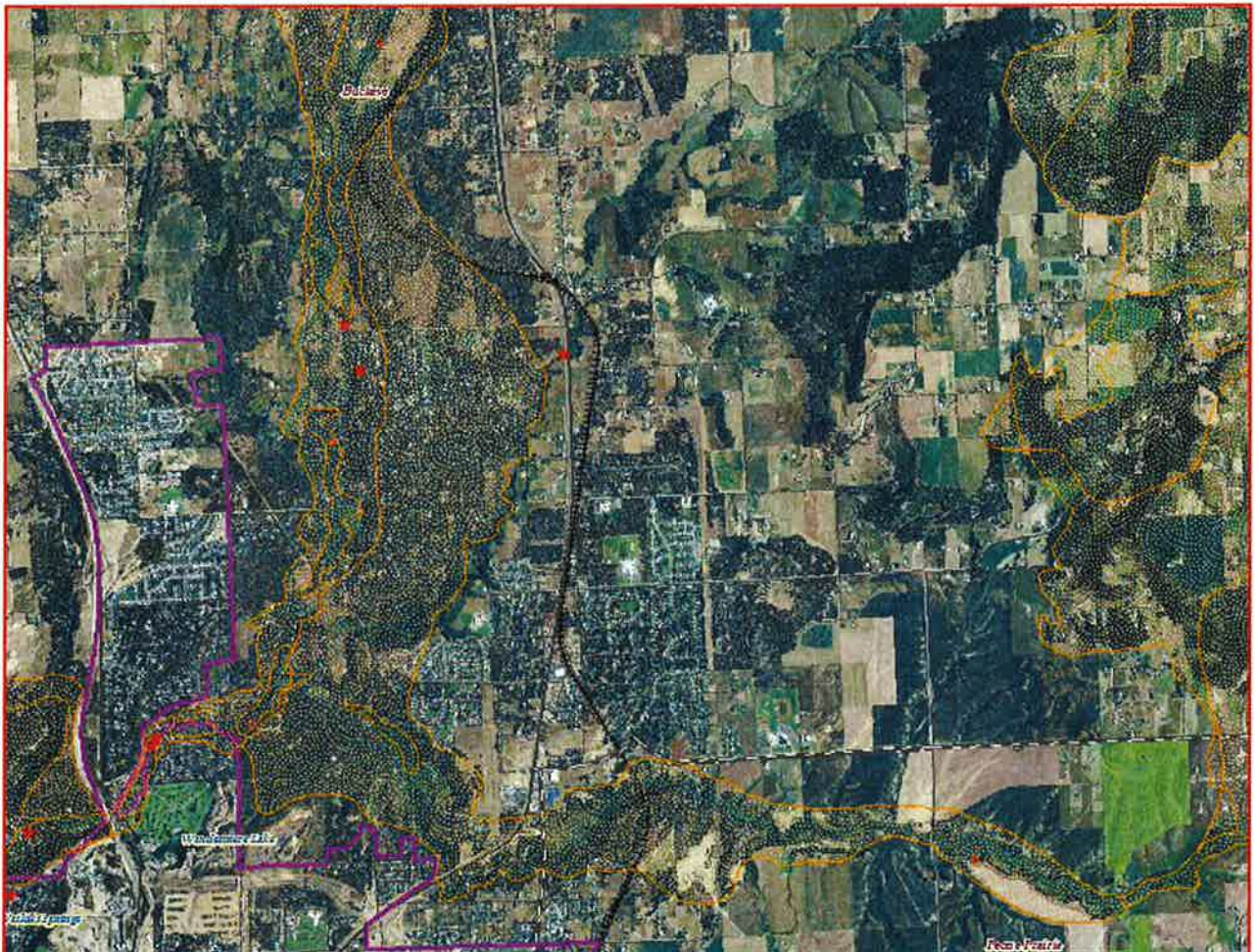
MT SPOKANE

REGULARLY OCCURRING INDIVIDUALS. SIGNIFICANT YEAR ROUND USE. MOOSE CALVING AREA. CONCENTRATED WINTER RANGE FROM NEWMAN LAKE AREA TO FORKER ROAD.

WDFW would prefer that the North Metro area not be included in the UGA to ensure that moose can continue to travel between habitat areas without encountering increased development and resulting in the increase of human-moose interactions and potentially increasing the incidents of moose on Highway 2. While the Mead-Mt. Spokane UGA modification is within

LITTLE SPOKANE NATURAL AREA.

NESTING AND BROODING AREA FOR CAVITY NESTING DUCKS SPECIFIC SPECIES OBSERVED IN THE AREA INCLUDES HOODED MERGANSERS AND WOODDUCKS



Monte Del Ray

This area is a rather urban development within moose, elk, and white-tailed polygons. This area is pretty much a loss for wildlife if you follow the shape of the UGA modification proposal. The polygons are difficult to see on this map, but they encompass the entire area down to Hwy 290.

sitenameFORKER

gendes1 WHITE-TAILED DEER WINTER RANGE - MODERATE TO HEAVY USE AREA. AREA IS ALSO UTILIZ

gendes2 ED BY MOOSE PERIODICALLY, AND DURING SEVERE WINTERS

sitenameMOUNT SPOKANE

gendes1 ROCKY MOUNTAIN ELK YEAR ROUND USE AREA.

gendes2 SELKIRK ELK HERD.

sitenameMT SPOKANE

gendes1 REGULARLY OCCURRING INDIVIDUALS. SIGNIFICANT YEAR ROUND USE. MOOSE CALVING AREA.

gendes2 CONCENTRATED WINTER RANGE FROM NEWMAN LAKE AREA TO FORKER ROAD.



Southeast Valley:

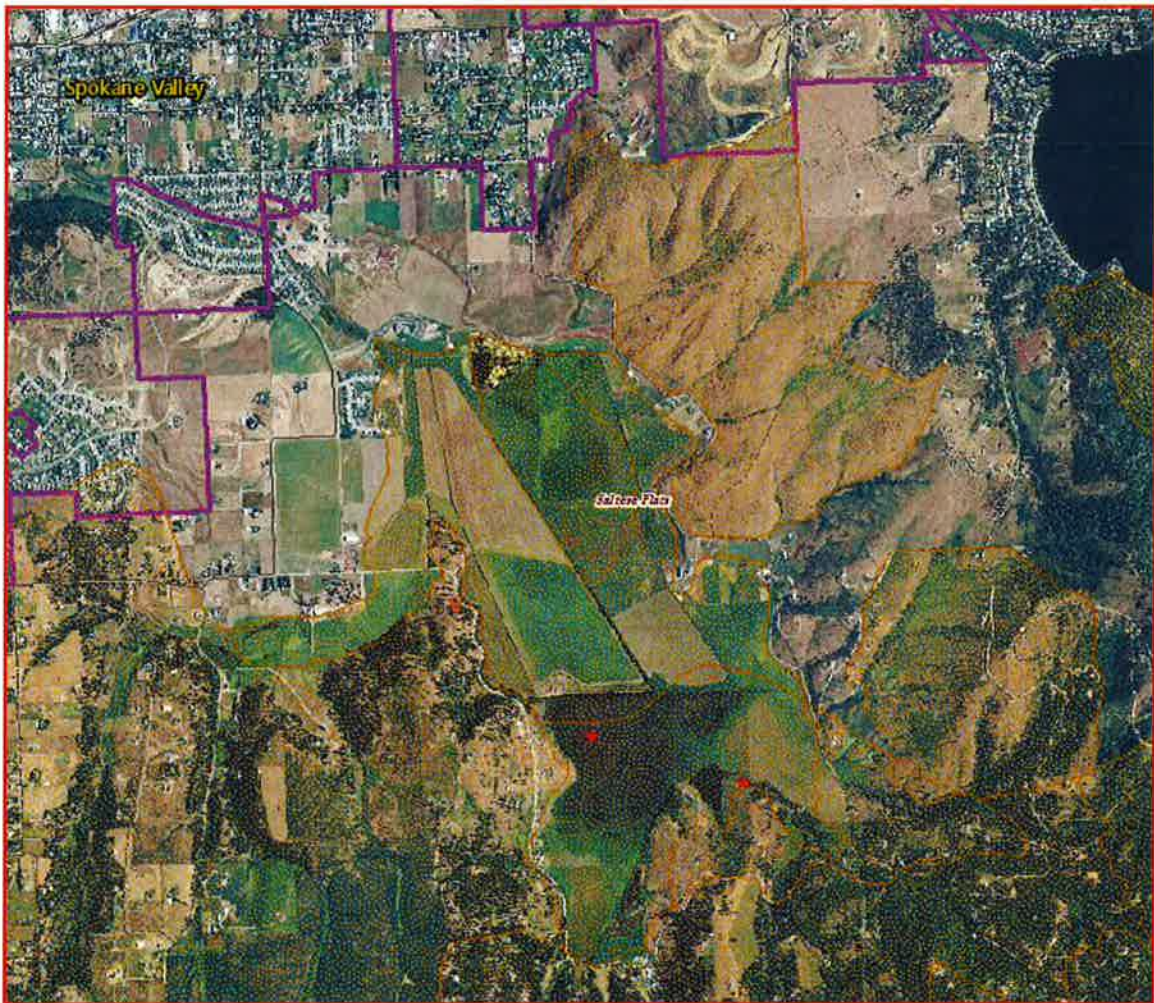
Saltese Flats is an important area for wildlife including waterfowl and raptors. Spokane County now owns portions of the Flats, as well as the recently acquired Conservation Futures on the NE slope, which is remnant priority steppe habitat. WDFW is concerned about classifying more of the land surrounding the Flats as urban. Expansion of the urban development adjacent to the flats will continue to put pressure on the habitat and the species.

sitenameSALTESE FLATS

WINTER WATERFOWL CONCENTRATIONS. MALLARD, PINTAIL, WIGEON, BUFFLEHEADS, TUNDRA SWANS. USED IN FALL AND EARLY SPRING.

sitenameSALTESE FLATS WETLANDS

EMERGENT WETLAND ASSOCIATED WITH SAVANNAH SPARROWS BREEDING AND MIGRATORY WATERFOWL, FORAGING RED-TAILED, ROUGH-LEGGED HAWKS & HARRIERS, WINTER BALD EAGLE FORAGING. RAVENS, COYOTES IN WINTER.



Moran Prairie-South Glenrose:

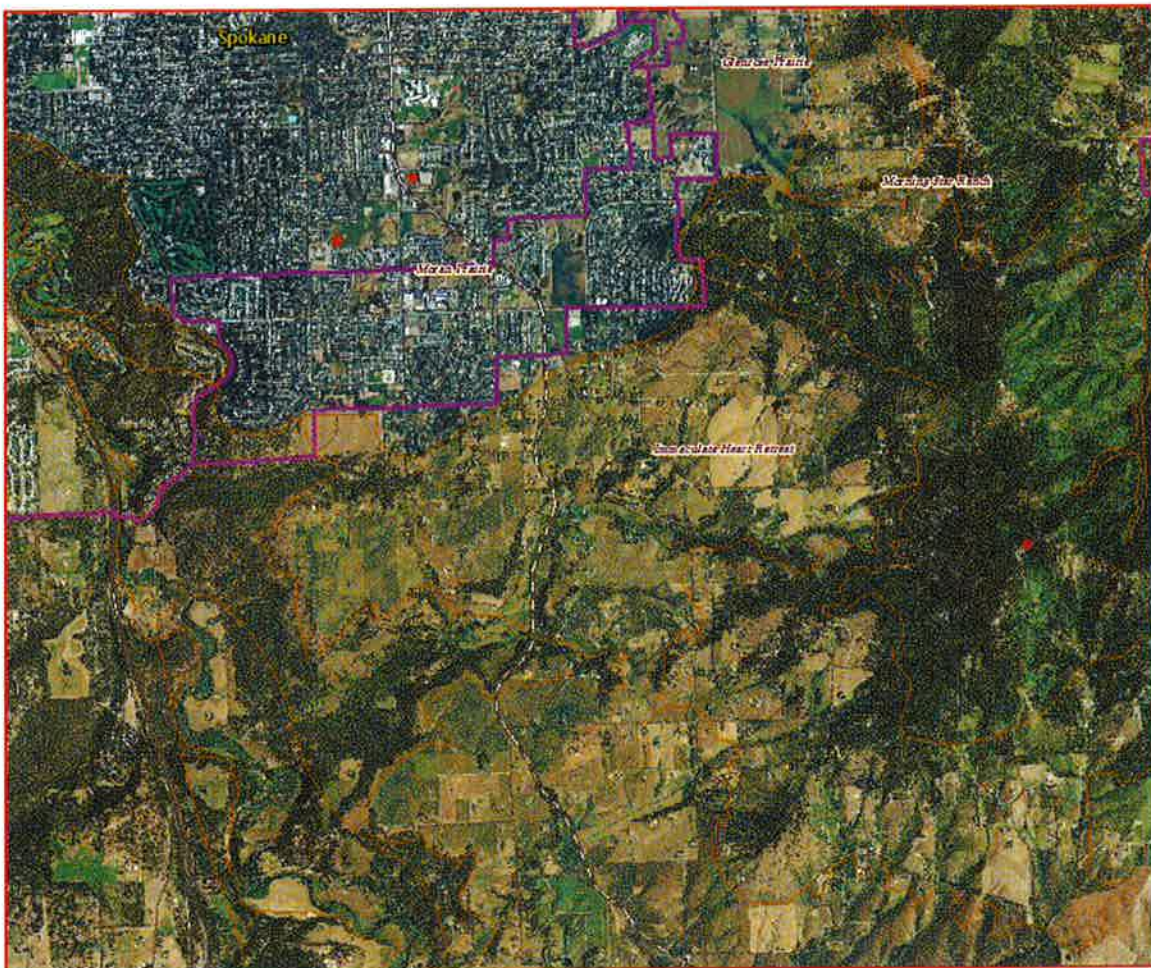
The main issue with this proposed modification is the Moran Prairie addition. Incorporating this entire area will lead to additional pressures right up to the boundaries of the Dishman Hills Corridor. Elk will shift to the south in response to increased encroachment.

DISHMAN HILLS CORRIDOR

BIODIVERSITY AREA CONTAINING NATIVE PONDEROSA PINE AND NATIVE UNDERSTORY. HABITAT HAS BEEN MAINTAINED DUE TO STATUS OF PROPERTY AS A NATURAL AREA. VALUABLE FOR LARGE UNGULATES, NEOTROPICAL BIRDS, AND BATS.

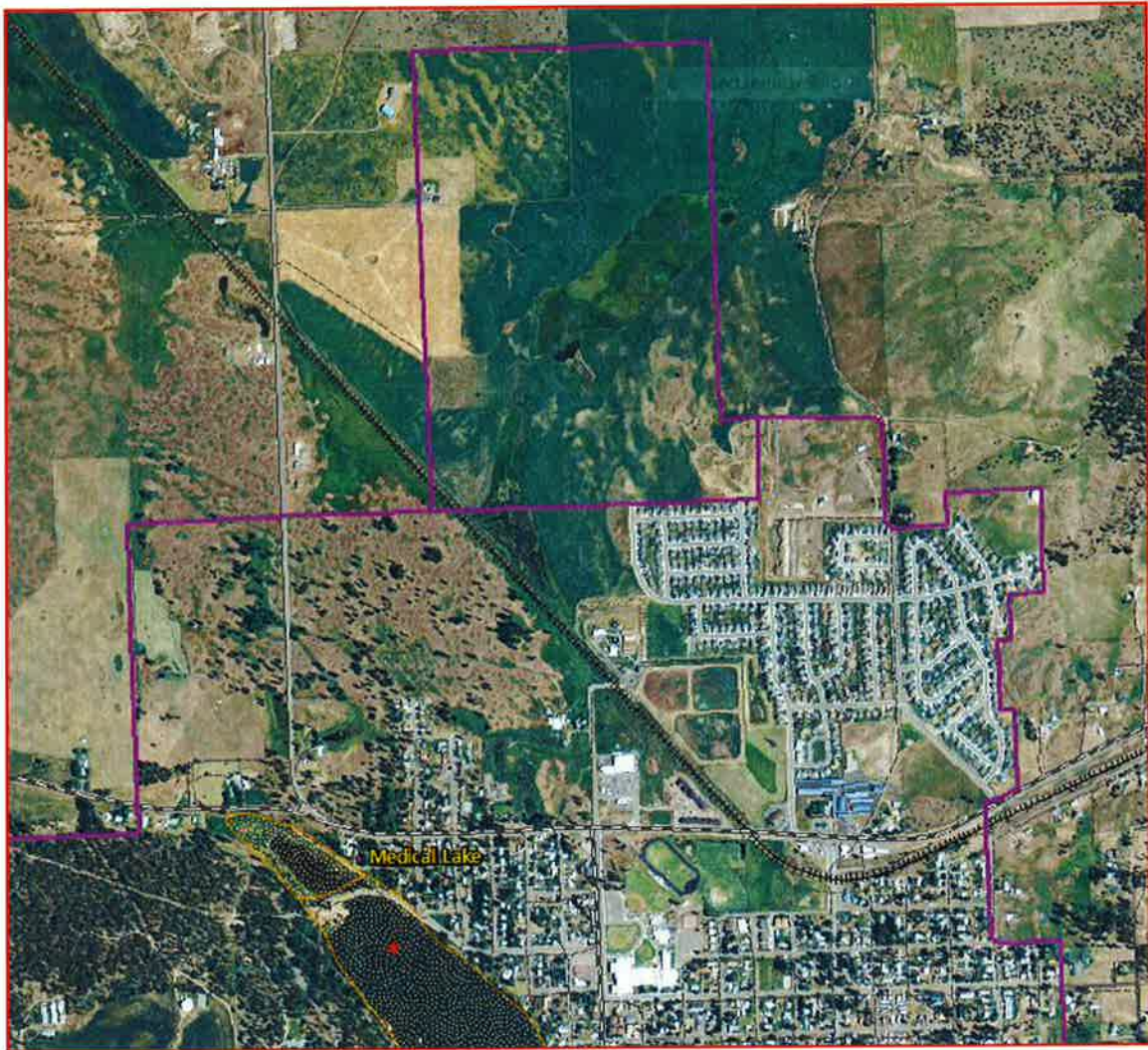
TOWER MOUNTAIN/MICA PEAK/TURNBULL

ROCKY MOUNTAIN ELK YEAR ROUND USE AREA. HANGMAN ELK HERD.



Medical Lake:

This is not currently mapped as PHS, but it appears that there is both wetland habitats and shrub-steppe and possibly steppe within this proposed UGA modification area.



Alternative 3: In summary, WDFW does not recommend Alternative 3 due to Priority Habitats and Species concerns. Include all of Alternative 2 concerns, plus the following:

Five Mile:

WDFW is concerned about this proposed modification. This entire area used to be mapped as PHS, and now only the rim is left - though development previously bisected the rim habitat. Developing the rest of the prairie with urban densities will devalue this important priority habitat that supports biodiversity of species.

EAST SLOPE FIVE MILE PRAIRIE

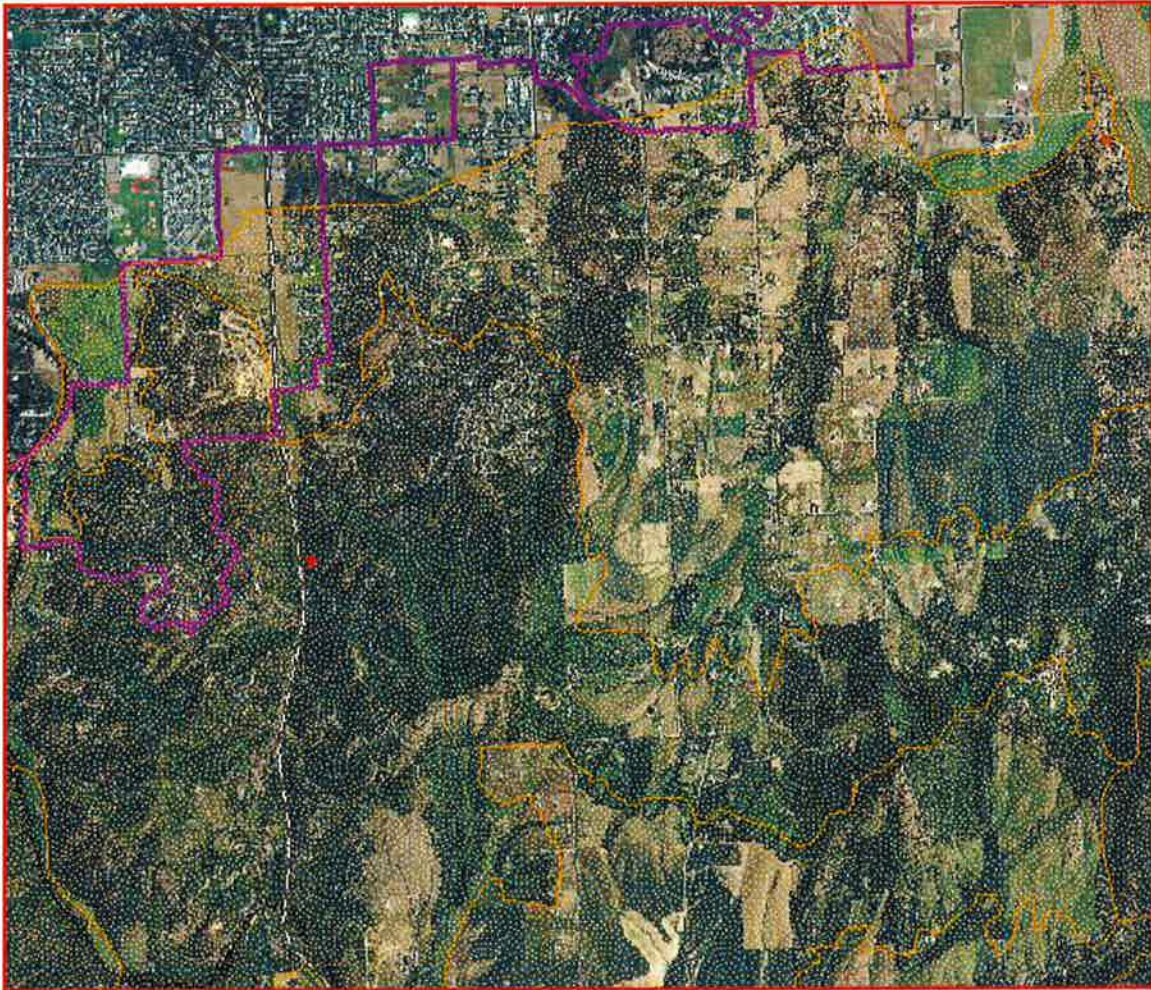
BIODIVERSITY AREA ON FIVE MILE PRAIRIE RIM. UNIQUE AREA CONSISTING OF NATIVE VEGETATION AND PONDEROSA PINE-DOUG FIR. FOREST SPECIES INCLUDE COOPERS AND SHARPSHINNED HAWKS, NEOTROPICAL MIGRANTS, DEER. LINKS TO LITTLE SPOKANE RIVER CORRIDOR.



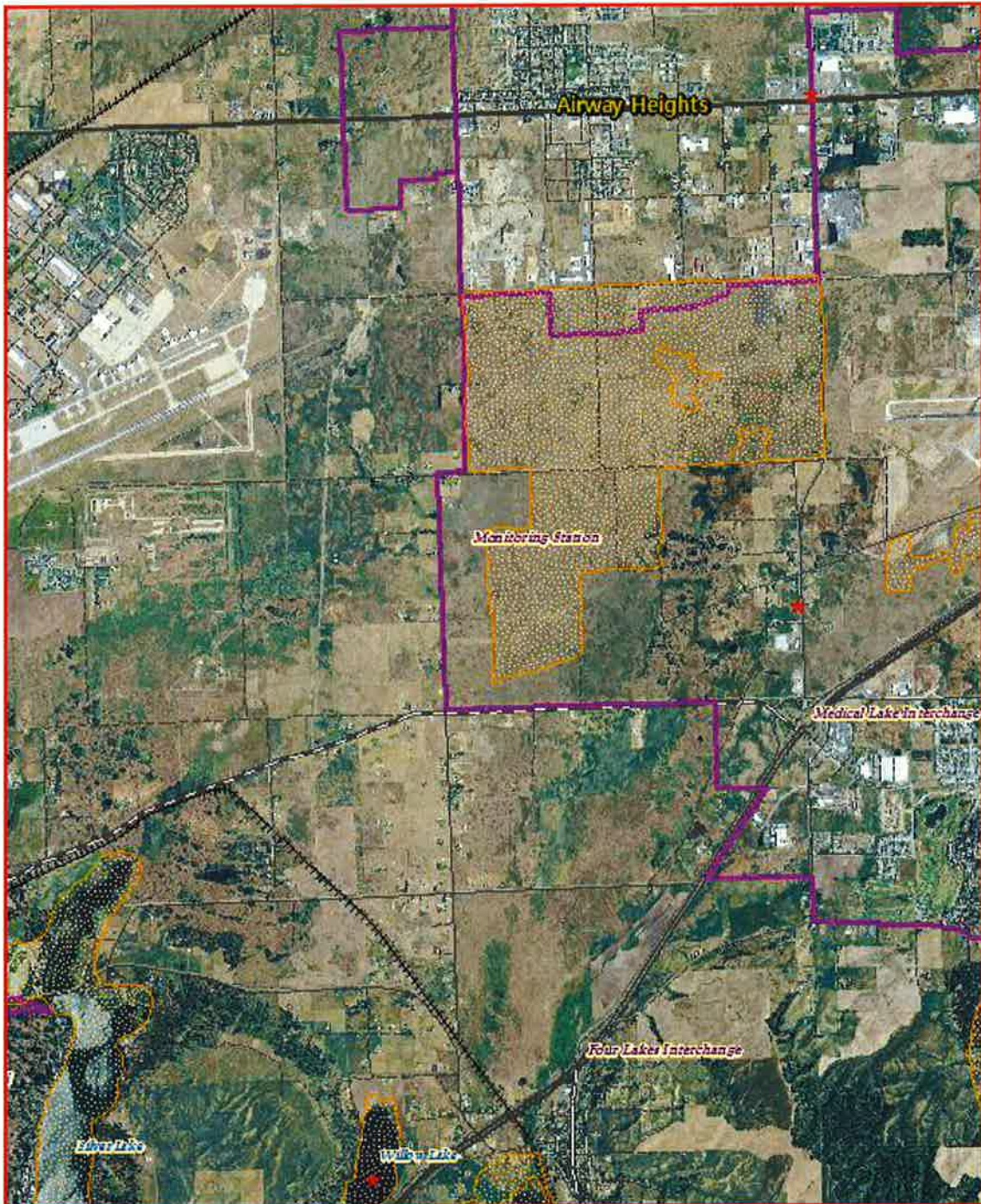
Belle Terre: This area, while developed, still has value for wildlife and elk are regularly observed year around. WDFW prefers that this area remain out of the UGA.

TOWER MOUNTAIN/MICA PEAK/TURNBULL

ROCKY MOUNTAIN ELK YEAR ROUND USE AREA. HANGMAN ELK HERD.

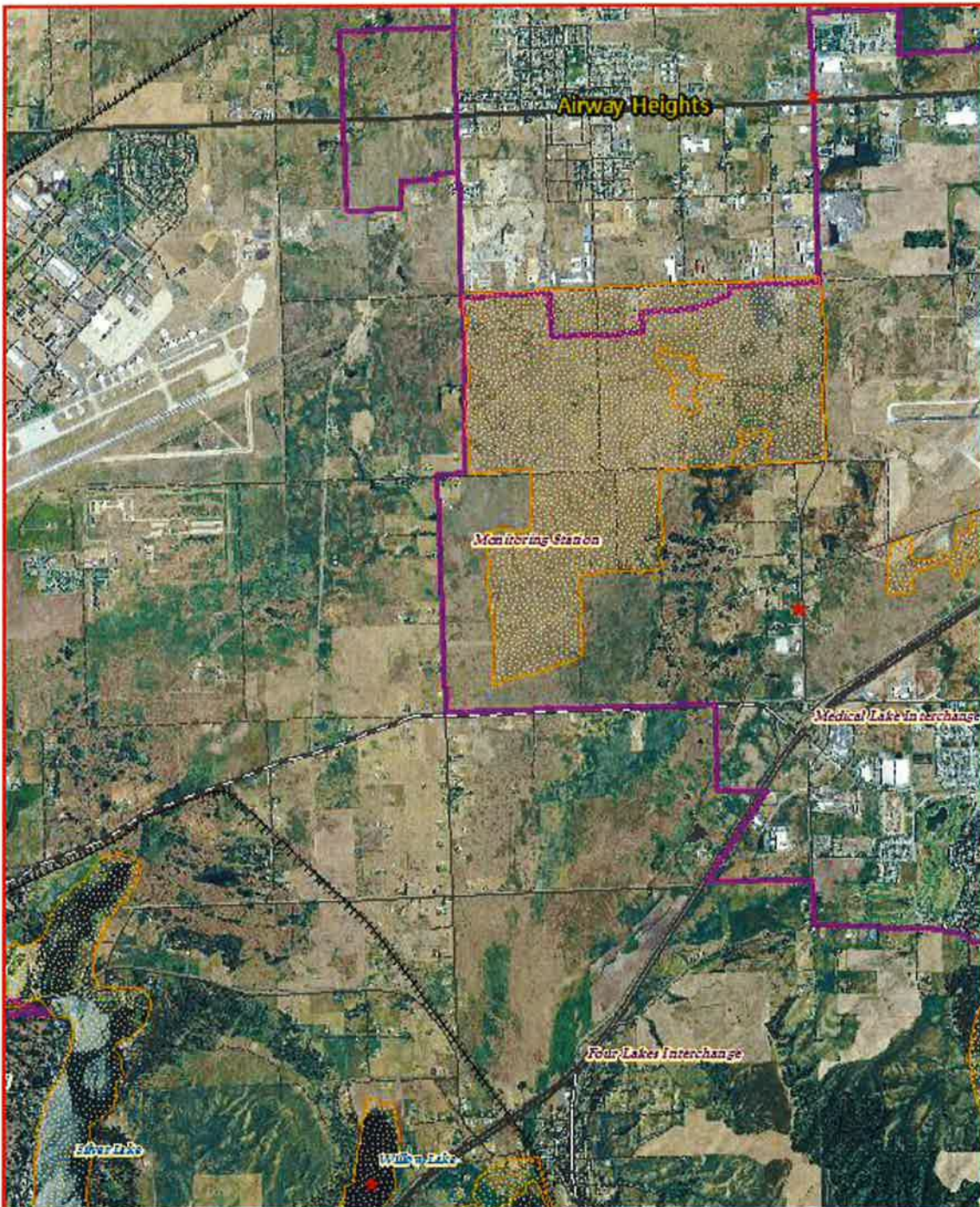


Proposed Jail Site: This site does not currently have mapped PHS, but appears to have critical areas including wetlands and shrub steppe habitat.



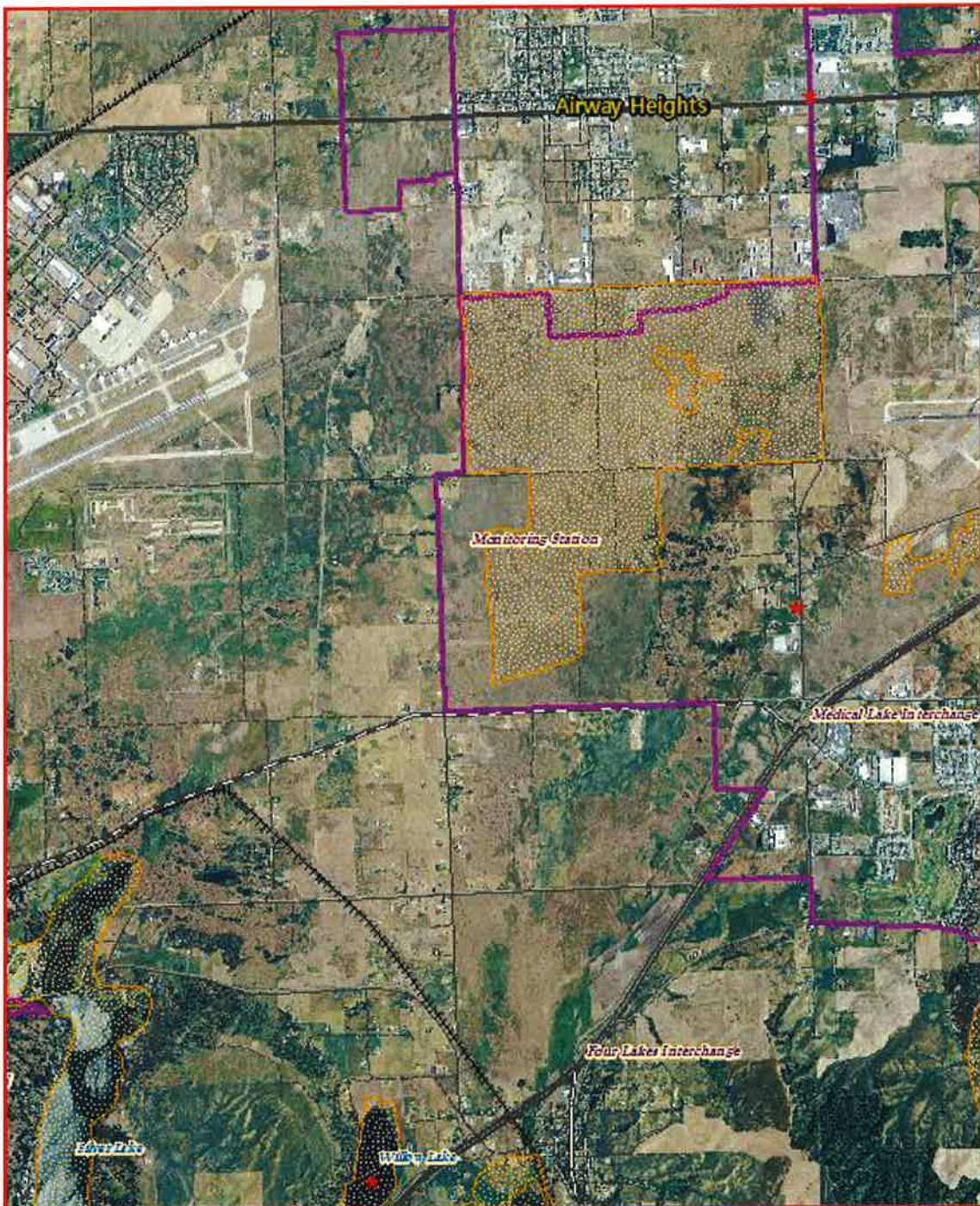
Alternative 4: In summary, WDFW does not recommend that the County choose Alternative 4 due to PHS/Critical areas impacts.

Geiger Spur: This area is not mapped PHS however there are wetlands and shrub steppe and steppe habitats. The shrub-steppe habitat polygons are clearly stopping at private land boundaries, but the habitat occurs outside of these polygons. WDFW is working to remedy this.



Alternative 4: In summary, WDFW does not recommend that the County choose Alternative 4 due to PHS/Critical areas impacts.

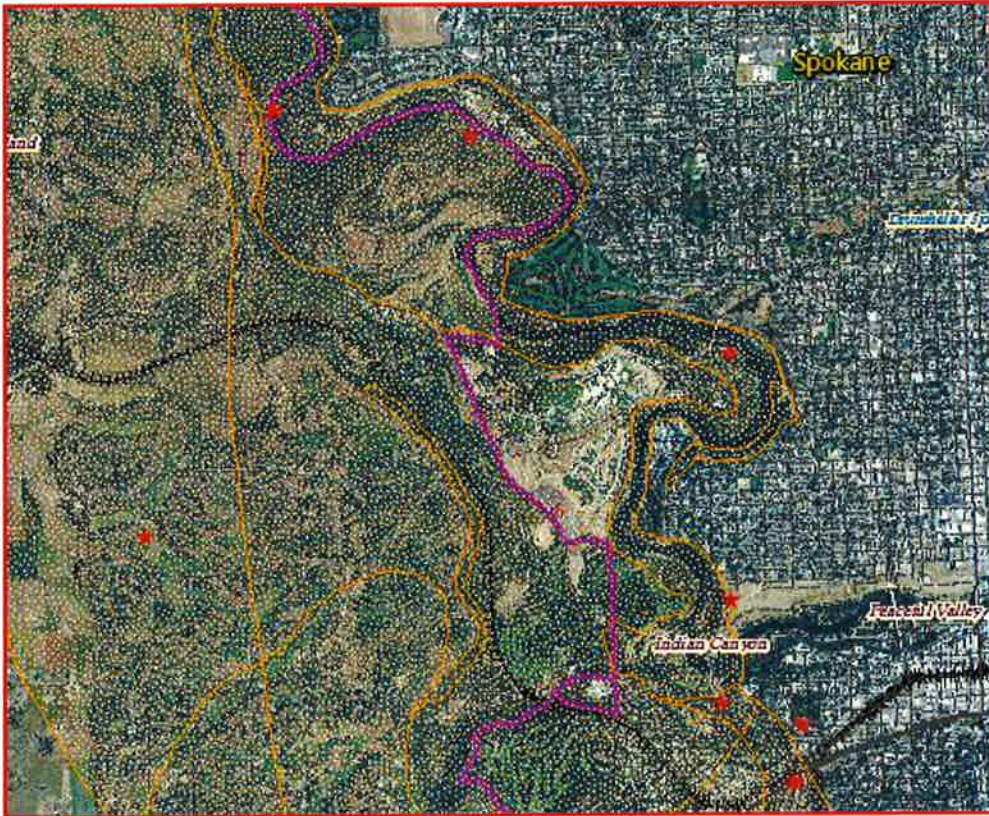
Geiger Spur: This area is not mapped PHS however there are wetlands and shrub steppe and steppe habitats. The shrub-steppe habitat polygons are clearly stopping at private land boundaries, but the habitat occurs outside of these polygons. WDFW is working to remedy this.



Palisades: WDFW does not recommend inclusion of this area in the UGA. It is within white-tailed deer winter range and mule deer winter range and the basalt cliff areas are unique. There are also significant areas of wetlands.

RIMROCK DRIVE - WHITE PARKWAY CLIFFS

BASALT CLIFFS ASSOCIATED W/ GREAT HORNED OWLS AND CLIFF SWALLOWS AND ROCK WRENS



Northeast Valley: See comments under Alternative 2.

Thank you for the opportunity to provide these comments. If you have any questions, please feel free to contact me at (509) 892-1001 ext. 323

Sincerely,

A handwritten signature in cursive script that reads "Karin A. Divens".

Karin A. Divens
PHS/GMA Biologist

KAD:kad

Response to Letter 17, WDFW
FSEIS, Spokane County Urban Growth Area Update

1. Fish and Wildlife comments

Response

Comments and analysis noted and incorporated in to the FSEIS.

Merriott, Vickie

From: Davenport, Steve
Sent: Wednesday, November 23, 2011 8:32 AM
To: Merriott, Vickie
Subject: FW: Urban Growth Area Update
Attachments: UGA Update - Eng Svcs Comments 11-22-11.pdf

From: Wright, Raymond [<mailto:rwright@spokanecity.org>]
Sent: Tuesday, November 22, 2011 3:52 PM
To: Pederson, John
Cc: Davenport, Steve; Engelhard, Scott; Figg, Greg; Brown, Eldon; Weinand, Kathleen
Subject: Urban Growth Area Update

John:

Attached, please see City of Spokane, Developer Services comments to the Urban Growth Area Update Draft EIS.

Thank you,

Raymond J. Wright, Jr., PE
Senior Traffic Planning Engineer
City of Spokane
509 625-6434

November 22, 2011



DEPARTMENT OF ENGINEERING SERVICES
TRAFFIC ENGINEERING

Mr. John Pederson
Spokane County Building and Planning
1026 W. Broadway Ave.
Spokane, WA, 99260

RE: Urban Growth Area Update

Dear John:

City of Spokane, Developer Services – has reviewed the Draft Supplemental Environmental Impact Statement (DSEIS) for the Urban Area Update in the context of how these recommended changes would impact City infrastructure. The City used the criteria established in the "UGA Update Service Provider Worksheet" with the results presented below. The City asks that this worksheet be included and considered when evaluating the recommended expansion.

In summary, several of the recommended Urban Area Updates are in areas with little or no infrastructure to support the recommended change. Very little detail is presented in the draft identifying strategies to provide the necessary services to support the recommended UGA boundary line adjustments. The City requests that deficiencies be addressed in the Final Environmental Impact Statement.

UGA Update Service Provider Worksheet

Please rate each study area on a scale of 1 to 5. 1= easy to serve. 5 = difficult to serve. Please consider the initial infrastructure investments and construction as well as long term service and maintenance.

Study Area: Mead – Mt. Spokane

Rate: 1

Barriers to service/already serving/other notes?:

Some sewer service, water, transportation can be provided as the area grows as long as the state and county has a strategy to accommodate the growth and a funding mechanism to provide the infrastructure.

Study Area: North Metro

Rate: 2

Barriers to service/already serving/other notes?:

Large tracts of property, no sewer, little water service. Area will be adjacent to a new interchange, this will change the dynamics of the area. With a reasonable investment up front, and with properly planned land use, this area may feasibly be developed.

Study Area: Glen Rose

Rate: 5

Barriers to service/already serving/other notes?:

Physical barrier, hillside cliff to prairie. Sewer limitations, little water service, poor road infrastructure.

Study Area: Moran Prairie

Rate: 5

Barriers to service/already serving/other notes?:

Limited water and sewer, poor roads, encourages sprawl.

Study Area: West Plains – Thorpe

Rate: 3

Barriers to service/already serving/other notes?:

City water and sewer available, Several restrictive points in the transportation network. Piecemeal light industrial to date, very substandard. Expensive to address transportation issues.

Study Area: Geiger Spur

Rate: 5

Barriers to service/already serving/other notes?:

Untimely, area all around is vacant. Virtually no infrastructure. Encourages sprawl.

Study Area: Pillar Rock

Rate: 2

Barriers to service/already serving/other notes?:

Water and sewer are available. Transportation is available and mitigation has been identified to address the future growth. A viable funding mechanism to provide the transportation upgrades has not been determined.

Study Area: Little Spokane

Rate: None

Barriers to service/already serving/other notes?:

Too far outside the City of Spokane's jurisdiction to comment.

Study Area: Five Mile

Rate: 3

Barriers to service/already serving/other notes?:

All services are available. Transportation infrastructure will always be substandard without significant expenditures that cannot be supported by ultimate build out. All residential zoning, no commercial. Drainage issues will be costly as well. Encourages sprawl.

Study Area: Jail Site

Rate: 2

Barriers to service/already serving/other notes?:

No sewer and water system. To provide these systems, development will be expensive. Access to good transportation is available; however, the growth anticipated is significant and will require new infrastructure to support the growth. This may include a new interchange and connecting roads at Medical Lake.

Study Area: Havana - Lyons

Rate: 3

Barriers to service/already serving/other notes?:

Drainage issues. No sewer service and if one is developed will require pumping which will be expensive. Physical transportation system is not in-place today to support growth.

Study Area: Pallsades

Rate: 5

Barriers to service/already serving/other notes?:

Basalt cliffs, no sewer, water or transportation. This will be expensive to develop.

Thank you for the opportunity to comment,



Raymond J. Wright, Jr., P.E.
Senior Traffic Planning Engineer
City of Spokane

**Cc: Davenport, Planner 3, Spokane County
Engelhard, Spokane County Engineers
Figg, WSDOT Transportation Planner
Brown, PE – Principal Eng. Developer Services
Weinand, Planning Services
File**

**Response to Letter 18, ~~WDAW~~
FSEIS, Spokane County Urban Growth Area Update**

1. City of Spokane comments

Response

Comments and analysis noted and incorporated in to the FSEIS.



Library Facilities

Master Plan
2010–2030

Look inside.

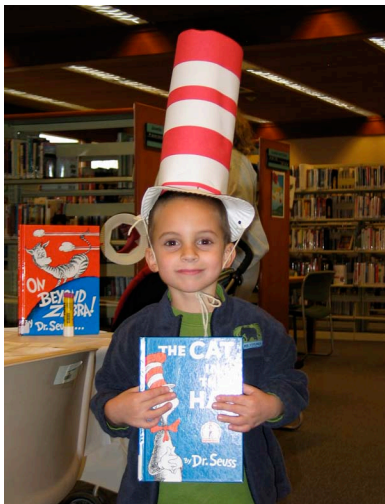
SPOKANE COUNTY
LIBRARY DISTRICT



www.sclld.org

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Executive Summary

INTRODUCTION

Spokane County Library District has been serving residents of the unincorporated county and affiliated municipalities for almost 70 years. Established by voters in 1942, it's a special purpose district whose sole purpose is providing public library services. Besides the County's unincorporated area, it includes the cities and towns of Airway Heights, Cheney, Deer Park, Fairfield, Latah, Medical Lake, Millwood, Rockford, Spangle, Spokane Valley and Waverly. By 2000, the District had grown to 10 libraries, the number it has today.

The District is an interconnected network of libraries that share resources and work together to serve District residents, most of whom use more than one branch. The resource libraries are North Spokane and Spokane Valley, with Cheney taking on a sub-resource library role for the Southwest County. The community libraries are Airway Heights, Argonne, Deer Park, Fairfield, Medical Lake, Moran Prairie and Otis Orchards.

Library services have changed significantly since facilities of the 1980s and 1990s were built and the District has been fortunate in being able to respond in large part to these as well as growing community needs and desires for services. However, the point has been reached in most facilities where there's insufficient physical space, and in some cases infrastructure, to accommodate the combination of evolving services and steadily increasing customer use. Anticipated service area population increases will only worsen the situation. Therefore, a comprehensive plan for needed facility improvements was undertaken.

The Library Facilities Master Plan is a management tool to explain and communicate needs, and guides short-term and long-range facility decisions. It's a roadmap to the future that responds to service changes and population growth.

NEEDS ASSESSMENT

Community Research

Strategic Research Associates conducted customer and community telephone surveys, three focus groups and developed the script for community leader interviews conducted by District staff and trustees. All phases of community research were completed by the end of 2008. Research showed common needs were for more materials (especially audiobooks and DVDs), more computers and additional areas for quiet reading and study.

Population Growth

Spokane County's Geographic Information Systems (GIS) department used available county population increase information and applied it to the District's service area, with breakdowns by geographic region: North County, Spokane Valley, Southwest County, Southeast County, and Moran/Glenrose Prairie. It showed an estimated 25.4% population increase by 2031 for the District, with numbers varying by region.

Facility and Site Evaluations

Senior staff evaluated each facility and site to assess how well they function. Building evaluation areas were customer and public considerations; building systems; technology, staff considerations and experiential considerations. Site evaluations included proximity to popular destinations; accessibility and visibility; capacity; geographic distribution; image of surroundings and legal issues. The primary overall deficiencies identified were inadequate shelving capacity, too few public-access computers, the lack of quiet study areas and general noise separation, undersized meeting rooms, and problems with staff work areas. The seven primary uses of facility space were identified and current capacity measured against current and future library service needs, as well as available information on best practices. In all cases the need for significant increases by 2030 was identified.

Public Comment on Draft Plan

During an April-May 2010 comment period, community was offered several opportunities to read and comment on the March 13 plan draft and its recommendations. The plan draft was posted on the District's website and a method was provided to email comments; informational open houses were held in each of the District's four geographic regions; and city and county officials were invited by letter to provide their comments. This process resulted in very little input.



RECOMMENDATIONS

Guiding Principles

The following general policies form the basic framework from which to view facility recommendations.

- Provide library services for all
- Build on current strengths
- Serve as centers for technology access
- Serve as a cultural and education center for community
- Create libraries that are sustainable and promote efficiency

Factors Considered

Many factors, some competing, must be considered in planning to meet long-term library facility needs. They include the adequacy of existing facilities, the changing role of the library in the community, changing demands for services and programs and anticipated population and demographic changes. Physical geography and routes of travel also play important rolls, as is minimum building size. If a library is to offer the typical range of standard services and materials, even on a small scale, there's a square footage below which it can't effectively function regardless of the service area population (experience has shown this to be no less than 4,000 square feet). For the most part, all of the above factors translate to more overall physical space in varying amounts throughout the District's service areas.

Key Recommendations for Meeting 2030 Library Service Needs

More space to read, learn and gather: More than double the total library system square footage to a minimum of 0.50 overall library space per capita and a minimum of 0.50 square feet per capita in each service region. Although best practices indicate a need for 0.60–1.0 square feet per capita, current and future operation funding limitations argue for 0.50 as a more achievable goal. This plan would provide an overall 0.57 square feet per capita, including administrative and support services space.

Collections: More than double the number of books and media items to achieve an increase from the current 1.69 items per capita to 2.63 per capita in 2030, slightly exceeding the low-end best practices, 2.5 items per capita.

Seating: Increase by 119%, from 2.5 seats per 1,000 service area residents to 4.1 per 1,000, slightly exceeding the high-end best practices measure of 4.0.

Group study space: Triple, from 45 current seats to 132. This is well below the best practice standard in large part because of expansion limitations for existing facilities that aren't to be replaced.

Programming and meeting room space: More than double seating, from 585 currently to 1,365, and a minimum meeting room capacity of 50. The best practice for meeting rooms is 75 to 200 seats in a location. Due to expansion limitations for existing facilities, the 75-seat minimum can't be met in the District's three smallest facilities.

Public access computers: Increase from the current 145 (0.58 per 1,000 population) to 312 (0.92 per 1,000). The best practice for public access computers is 1 to 2 per 1,000 population. This is slightly below the minimum 339 required to meet the 1 per 1,000 population standard and once again reflects space expansion limitations in our smaller facilities.

Staff work space: Eliminate all undersized, scattered, awkwardly configured or not acoustically enclosed work space.



Administrative and support services space: Increase from the current 12,400 square feet of space in two separate buildings to 15,000 square feet in a single building.

Convenience: For the Metro Spokane area, library facilities are located within two miles or a 15-minute drive for most residents or 30-minute drive in rural areas.

Implementing Key Recommendations

Facility recommendations respond to key recommendations and projected library service needs as measured against the realities of physical geography, travel patterns and economies of scale.

- Maintain the resource library/community library model
- Replace Cheney, North Spokane and Spokane Valley Libraries with new facilities on different sites
- Build three new libraries: Conklin Road, South Spokane Valley and Spangle
- Expand and/or remodel the Airway Heights, Argonne, Deer Park, Fairfield, Moran Prairie, and Otis Orchards Libraries
- Neither remodel nor expand the Medical Lake Library
- Expand and remodel the Administrative Offices/Support Services facility

	2010 Actual		2030 Recommended		
	SF	SF/Capita	SF	SF/Capita	Improvement
North County	26,050	0.36	42,850	0.46	
North Spokane Library	18,850		35,000		Relocation
Deer Park Library	7,200		7,850		Expansion
Spokane Valley	38,400	0.30	93,425	0.61	
Spokane Valley Library	22,950		50,000		Relocation
Conklin Road Library	0		12,000		New branch
South Valley Library	0		12,000		New branch
Argonne Library	9,650		11,525		Expansion/Remodel
Otis Orchards Library	5,800		7,900		Expansion/Remodel
Southwest County	14,900	0.30	25,600	0.40	
Cheney Library	6,600		15,000		Relocation
Airway Heights Library	4,200		6,500		Expansion/Remodel
Medical Lake Library	4,100		4,100		None
Southeast County	2,700	0.37	7,500	0.56	
Fairfield Library	2,700		3,500		Expansion/Remodel
Spangle Library	0		4,000		New branch
Moran/Glenrose Prairie	8,400	0.53	9,400	0.55	
Moran Prairie Library	8,400		9,400		Expansion
Total	90,450	0.33	178,775	0.53	
Admin/Support	12,400	n/a	15,000	n/a	Expansion/Remodel

Facility Component Comparison								
				2010				2030
				Mtg				Mtg
				Room				Room
	Collection	Seats	Computers	Seats	Collection	Seats	Computers	Seats
Airway Heights	16,401	39	8	30	21,000	60	14	60
Argonne	42,061	79	15	50	54,000	100	22	100
Cheney	40,780	49	11	50	101,500	140	28	100
Conklin					101,000	136	30	100
Deer Park	33,116	75	13	50	37,500	100	22	100
Fairfield	9,124	25	5	30	12,000	35	8	50
Medical Lake	17,796	34	7	30	18,200	34	10	30
Moran Prairie	37,218	31	12	100	40,000	80	18	100
North Spokane	100,776	140	25	100	162,000	225	45	200
Otis Orchards	25,647	44	10	30	32,000	64	15	75
South Valley					101,000	136	30	100
Spangle					16,000	40	10	50
Spokane Valley	124,878	123	39	100	195,250	250	60	300
Total	447,797	639	145	570	891,450	1,400	312	1,365
District per capita	1.78				2.63			
District per 1,000		2.53				4.125		
District per 10,000			5.75				9.19	

IMPLEMENTATION

Funding

Three financing methods for capital projects are available to the District: Accumulation of normal maintenance and operations funds; short-term non-voted financing repaid from normal maintenance and operations funds; and voter-approved general obligation bonds. There are no federal or state grants or matching fund programs. Only the third option—voter-approved general obligation bonds—is feasible for anything other than a small project. Within the voter approved general obligation bonds there are two options available: one or more District-wide bond proposals or formation of individual Library Capital Facility Areas to finance projects within those geographic areas.

Recommendation

A single District-wide bond issue approval with a phased bond sale would be preferable to individual LCFAs. It would assure all improvements would be made in an integrated fashion and is the only method that would provide funds for the needed Administration/Support Services space.

Operational Sustainability

Even with anticipated efficiencies in facility design and operations, it will cost more to maintain and operate additional and expanded buildings. No bond issue proposal for facilities should be placed before voters unless there's a reasonable expectation that additional adequate funding will be available to operate them. To implement the proposed facility plan, it will be necessary to maintain the levy rate as close as possible to its \$0.50 per \$1,000 maximum statutory level. This will require ongoing monitoring of changes in the District's property tax base, and levy rate and voter support of periodic levy lid lift proposals.

Project Costs

A library project budget includes construction as well as design fees, permitting costs, furniture and equipment, new library materials, administrative costs, contingency amounts and sales tax. The construction costs component, which comprises the largest part, uses \$210 per square foot for new construction and \$160 per square foot for remodeling, estimates provided by District consultants, Integrus Architecture and Roen Associates. These costs are in 2010 dollars; it will be necessary to consider inflation as a factor or the year in which construction will take place.

	Total Cost
North County	
Replace North Spokane Library	12,470,000
Deer Park Library: Addition	204,000
Totals	12,674,000
Spokane Valley	
Replace Spokane Valley Library	15,563,000
New Conklin Road Library	5,101,000
New South Valley Library	5,104,000
Argonne Library: Addition & Remodel	983,000
Otis Orchards Library: Addn & Remodel	756,000
Totals	27,507,000
Southwest County	
Replace Cheney Library	4,961,000
Airway Heights Library: Addn & Remodel	819,000
Totals	5,780,000
Southeast County	
Fairfield Library: Addition & Remodel	387,000
New Spangle Library	1,475,000
Totals	1,862,000
South Suburban	
Moran Prairie Library: Addition	318,000
Administration/Support Services	
Addition & Remodel	2,660,000
Grand Total	50,801,000



Priorities

To meet service area facility needs through 2030, all recommendations should be implemented and all facility improvements completed no later than that date. However, some current individual facility deficiencies are greater than others and some service areas have more critical current square footage deficiencies. Facility improvements are, therefore, grouped on the basis of current needs and anticipated future service area population increases. The following listing assumes a 2013 ballot issue approval and three separate bond sales over a seven-year period.

Phase 1: 2013-2016

Design, construction and opening

- Spokane Valley Library replacement
- Administration/Support Services addition/remodel

Bond sale: Early 2014

Phase 2: 2015-2020

Design, construction and opening

- New Conklin Road Library
- Cheney Library replacement
- Airway Heights Library addition & remodel
- New Spangle Library
- New South Valley Library

Bond sale: Early 2016

Phase 3: 2019-2024

Design, construction and opening

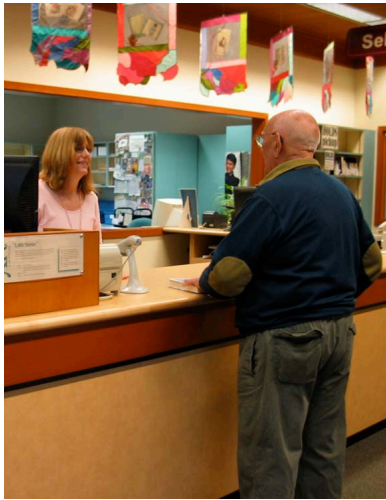
- North Spokane Library replacement
- Fairfield Library addition/remodel
- Argonne Library addition/remodel
- Otis Orchards Library addition/remodel
- Deer Park Library addition
- Moran Prairie Library addition

Bond sale: Early 2020



Introduction

SPOKANE COUNTY LIBRARY DISTRICT TODAY



Spokane County Library District has been serving residents of the unincorporated county and affiliated municipalities for almost 70 years. Established by voters in 1942, it's a special purpose district whose sole purpose is providing public library services.

Besides the county's unincorporated area, it includes the cities and towns of Airway Heights, Cheney, Deer Park, Fairfield, Latah, Medical Lake, Millwood, Rockford, Spangle, Spokane Valley and Waverly. All but Airway Heights, which contracts for service, have annexed to the District. The cities of Liberty Lake and Spokane aren't part of the District and operate independent libraries. By 2000, the District had grown to 10 libraries, the number it has today.

The District is an interconnected network of libraries that share resources and work together to serve District residents, most of whom use more than one branch. The resource libraries are North Spokane and Spokane Valley, with Cheney taking on a sub-resource library role for the Southwest County. The community libraries are Airway Heights, Argonne, Deer Park, Fairfield, Medical Lake, Moran Prairie and Otis Orchards. The District owns all but three facilities, which are provided by their cities: Cheney, Fairfield and Medical Lake.



Library services have changed significantly since facilities of the 1980s and 1990s were built. There are many new formats for library materials. Customer computer use has grown well beyond the online catalog for access to and use of library-provided digital resources and Internet access, including Wi-Fi. There is increased demand for group study areas. Finally, the role of the library as a community gathering place has increased.

Through ongoing planning, the District has been able to respond in large part to these growing community needs and desires for services consistent with the two related Balanced Scorecard strategic themes: *Provide the right stuff at the right time* and *Serve as a community place*. However, the point has been reached in most facilities where there's insufficient physical space, and in some cases infrastructure, to accommodate the combination of evolving services and steadily increasing customer use. Anticipated service area population increases will only worsen the situation. Therefore, a comprehensive plan for needed facility improvements was undertaken.

IMPACT OF PREVIOUS FACILITY PLANNING

The District's current facilities are the product of four individual capital programs that began in the early 1980s and continued through 2006, a 25-year period during which all existing libraries were remodeled and expanded or replaced and three new branches were opened.

The first, funded by a voter-approved 1983 property tax levy lid override, completely rebuilt the 1955 Valley Library and doubled its size. The virtually new facility was completed in 1986. Then in 1988, bond funding

for a more ambitious capital improvement program was approved by voters. It included an expansion and total renovation of the 1972 North Spokane Library, tripling its size; construction of the Argonne facility to replace leased space housing the North Argonne Library and consolidating District administration and most support services into one building; construction of a new library serving the Otis Orchards area; furniture, equipment, and library materials for new city-built Cheney and Medical Lake libraries; a computer system upgrade and new library materials. These bonds were retired in 1998.

District voters approved a 10-year bond issue for a second large capital program in 1996. Over the next five years, Cheney and Fairfield libraries were expanded and remodeled; new libraries were built in Airway Heights and Deer Park to replace substandard facilities provided by the cities; a new storefront library in Moran Prairie was equipped and stocked; and once again there was a computer system upgrade and major materials purchases.

Finally, in 1993, Moran and Glenrose Prairie voters approved establishment of a Library Capital Facility Area to fund construction of the Moran Prairie Library, which replaced the storefront operation in 2006. Bonds for this project will be retired in 2016.

Although most of the facility needs that were eventually addressed had already been identified in 1982, no formal long-range plan was developed to address them. Each group of projects after the Spokane Valley Library renovation and expansion was chosen on the basis of the highest priorities at the time, those that could be realistically accomplished in five-year time periods. Another factor was the desire for previous bonds to be retired or be close to retirement before voters were asked to approve new ones.

WHY MASTER PLAN NOW?

A library facilities master plan is a management tool to explain and communicate needs, and guides short-term and long-range facility decisions. It's a roadmap to the future that responds to service changes and population growth.

Many aspects of the District's situation today are very different from what they were when the earlier, less comprehensive facility plans were developed. Two new cities have incorporated and the City of Spokane is more aggressively seeking annexations. Spokane County began planning under the state's Growth Management Act requirements, which include meeting Level of Service targets and the resulting capital facilities planning. The District's tax base—and thus its ability to support debt service—has increased greatly.

Although the service area's 2008-2031 population growth projection is only 25%, just over a relatively modest 1% per year, it must be planned for, especially in light of major facility space needs at the outset of that time period.

This Library Facilities Master Plan is the starting point.



Needs Assessment

COMMUNITY RESEARCH

In mid-2008, the District commissioned Strategic Research Associates (SRA) to conduct customer and community telephone surveys, three focus groups, and to develop the script for community leader interviews to be conducted by District staff and trustees. SRA worked closely with District administration in developing the survey, focus group, and interview instruments. All phases of the community research were completed by the end of 2008.



Customer Survey

Telephone interviews for the customer survey were conducted between August 21 and September 4, 2008, with 401 library cardholders aged 18 and over, living within the District's service area, who had visited a District library once within the past 12 months. Research measurement objectives included current use and perceptions about county libraries; anticipated future satisfaction with and use of county library programs and services, and recommendations for prioritizing potential facility improvement options.

Among the findings were:

89% reported location was the dominant factor in their choice of a favored library

46% said the library used most satisfies "all of your needs," 41% reported "most," and 13% expressed dissatisfaction

The most frequent recommendations for improvements were a wider selection of materials, a larger facility and more computers

The highest priorities for improvements were more books; more Internet computers; more audiobooks; more movie DVDs and quiet study areas

Asked to consider the longest acceptable drive time to a county library, the overall average was 15.4 minutes; half reported a limit of 15-minutes or less, a third 16-20 minutes, and 19% responded 21-minutes or more



Community Survey

Telephone interviews for the community survey were conducted between September 22 and October 14, 2008, with 403 heads-of-households, aged 18 and over, living within the District's service area. Research measurement objectives included current household use of public libraries; reasons for infrequent use of public libraries; anticipated use of public library programs and services; and recommendations for prioritizing potential facility improvement options.

Among the findings were:

A member of 75% of households visited a public library within the last 12 months; 41% used the website; 31% called; and 19% did all three

Families with children are 1.3 times more likely to visit

The highest priorities for improvements were more hardcover and paperback books; more audiobooks; quiet study areas; more computers; separate teen-friendly areas; more movies; and more easy-chair seating

The longest tolerable drive to a library was 15 minutes or less for 56% of respondents, 16-20 minutes for 22%, and 21-minutes or more for 20%. Frequent library users tolerate slightly longer drives than occasional users and non-users had the least tolerance for long commutes.

Focus Groups

Cardholder focus groups were held in November 2008 at the Cheney Library for the West Plains area, Spokane Valley Library for the Spokane Valley area, and North Spokane Library for the North County area. There were 19-20 participants in each. The primary objectives were to gauge current use and perception of libraries; potential library improvements to better meet the needs of library users; library-specific questions; and willingness for financial support for library expansion.

- 22% said the library they used most met their own and their families needs; 60% said it met "most" of their needs, and 17% said it met some or few of their needs
- In all three groups there was consensus that more comfortable seating and a "fresh coat of paint" would greatly increase library attractiveness and a majority felt that the libraries were somewhat outdated and the layout in some (especially Spokane Valley and North Spokane) could be improved
- Related to physical comfort improvements, the highest ratings were for more physically welcoming and better lighting over bookshelves
- The highest priorities for improvements were more books; more Internet computers; more audiobooks; more movie DVDs, more comfortable seating and more quiet study areas

Community Leader Interviews

In December 2008, trained District staff and trustees conducted personal on-site interviews with 26 area decision-makers selected by the District. The average interview was 25-30 minutes. Interviewees included city and county officials, school superintendents and Chamber of Commerce officials.

Significant findings included:

- Over half indicated SCLD was doing better than expected in meeting their community needs, but several said their regional area's size was too large for effective coverage
- Most-cited recommendations for near-term improvement were larger facilities, longer operating hours and more computers
- In prioritizing facility improvements, the highest average score was for adding more computers. Next were audiobooks, quiet study areas, larger meeting rooms and equipment, teen-friendly areas, more books and more comfortable seating
- Over half would recommend the community give at least moderately high priority to library bonds, yet schools, public safety and roads and bridges were identified by many as deserving a higher priority

2010 FACILITY SPACE

The District total for library gross square footage (SF) is 90,450. Gross square footage is defined as the sum of all areas on all floors of a building included within the outside faces of its exterior walls, including floor penetration areas, however insignificant, for circulation and shaft areas that connect one floor to another. It includes non-assignable spaces such as mechanical rooms, restrooms and corridors.

Administrative and support services consume an additional 12,400 SF of space in two different buildings, for a grand total of 102,850 SF.

SCLD Facility Square Footage	
Resource Libraries	Square Feet
North Spokane	18,850
Spokane Valley	22,950
Subtotal	41,800
Community Libraries	
Airway Heights	4,200
Argonne	9,650
Cheney	6,600
Deer Park	7,200
Fairfield	2,700
Medical Lake	4,100
Moran Prairie	8,400
Otis Orchards	5,800
Subtotal	48,650
Total Library Space	90,450
Support Services	
Administration Offices	10,700
Other District Support	1,700
Total Support Space	12,400
Grand Total	102,850



POPULATION CHANGES TO 2031

2009 Spokane County Library District Population

Every August, the State's Office of Financial Management (OFM) publishes population estimates as of April 1 for every county, county unincorporated area and city. These estimates are made for use in state revenue allocations having a per capita basis as well as for planning purposes. After each decennial census is published the OFM figures are reconciled, creating a new base for future year calculations.

The District's 2001–2009 annual population increases average is 1.8%, with a range of -0.2% to +3.5%. For 2009, it was 1.9% above 2008. At 252,230, it comprises 54.2% of Spokane County's total.

It's worth noting that more District residents (53.6%) live in the unincorporated county than in cities and towns. Of the 117,126 living in cities and towns, 89,440 (76.3%) are residents of the City of Spokane Valley.

Population		
Spokane County	465,000	
Total SCLD	252,230	
Unincorporated	135,104	
Incorporated	117,126	
Airway Heights ¹	5,515	<i>April 1, 2009 Office of Financial Management Population Estimates</i>
Cheney	10,550	
Deer Park	3,450	
Fairfield	590	
Latah	189	¹ Airway Height non-inmate population = approximately 3,380 (Airway Heights Correction Center capacity = 2,136)
Medical Lake ²	4,845	
Millwood	1,660	² Medical Lake non-institutional population = approximately 3,949 (Pine Lodge Corrections Center capacity = 359; Lakeland Village average daily census = 250; Eastern State Hospital average daily census = 287)
Rockford	493	
Spangle	275	
Spokane Valley	89,440	
Waverly	119	

2008 Demographic and Social Characteristics

Public library services and programs are for the most part a reflection of community needs and desires. Those needs and desires can be influenced by demographic and social characteristics of the service area population. For example, a community where Spanish is spoken at home by 40% of its residents has a much greater need for Spanish-language materials and for programs that reflect Hispanic culture than one with few Spanish speakers at home. Similarly, a retirement community's needs are quite different from one with a high percentage of children.

The following characteristics help define the District's service area population and inform its decisions on services and programs: age; recent immigration; languages other than English spoken at home or less than "very well;" education and income.

2008 estimates are from the U.S. Census Bureau's American Community Survey, done annually for geographic areas with a population of 65,000 or more. Due to the data set parameters, this information is available only for Spokane County, City of Spokane and City of Spokane Valley. Data for the District as a whole was computed by subtracting the City of Spokane from Spokane County, leaving a margin of error because it includes City of Liberty Lake.

SCLD 2008			
	Estimate	Percent	
Age Groups			
Under 5	14,489	5.7	
5 to 19	52,530	20.6	
20 to 24	16,309	6.4	
25 to 44	66,601	26.2	
45 to 64	71,818	28.7	
65+	32,842	12.9	
Educational Attainment, Age 25+			
High school or higher	155,387	93.1	
Bachelor degree or higher	45,464	26.5	
Foreign Born			
Entered 2000 or later	2,790	n/a	
Entered before 2000	8,872	n/a	
Language Spoken at Home, Age 5 and Over			
English only	224,358	93.4	
Other than English	15,742	6.6	
Speak English less than "very well"	5,771	2.6	
Income Below Poverty Level			
Only percentages are available for Spokane County as whole, Spokane, and Spokane Valley. Without their estimated numbers the SCLD percentage can't be computed.			
	Spo County	Spo City	Spo Valley
Families	8.9%	11.8%	7.6%
All people	13.7%	18.0%	10.4%

2031 Spokane County Library District Population Estimates

Washington's Growth Management Act requires the Spokane County plan to maintain adequate services levels for future population growth. Toward that end, OFM provides counties with population increase estimate ranges that their legislative authorities are to allocate among jurisdictions, including their designated Urban Growth Areas.

In 2009, the District commissioned Spokane County's Geographic Information Systems (GIS) department to use whatever county population increase information was available by geographic area and apply it to the District's service area. Further breakdowns were done by District geographic region and by rural, UGA and cities within each region. It's important to note the discrepancy between the 2009 OFM estimate of 252,230 and the Spokane County GIS 2008 estimate of 270,688 for the District's total population. Other than a small difference due to the estimates being a year apart, most of the remainder is in the unincorporated county.

The table below shows an estimated 25.4% increase in the District's population by 2031 as well as varying amounts by region and regional breakdown. These figures are the basis for facility space recommendations.

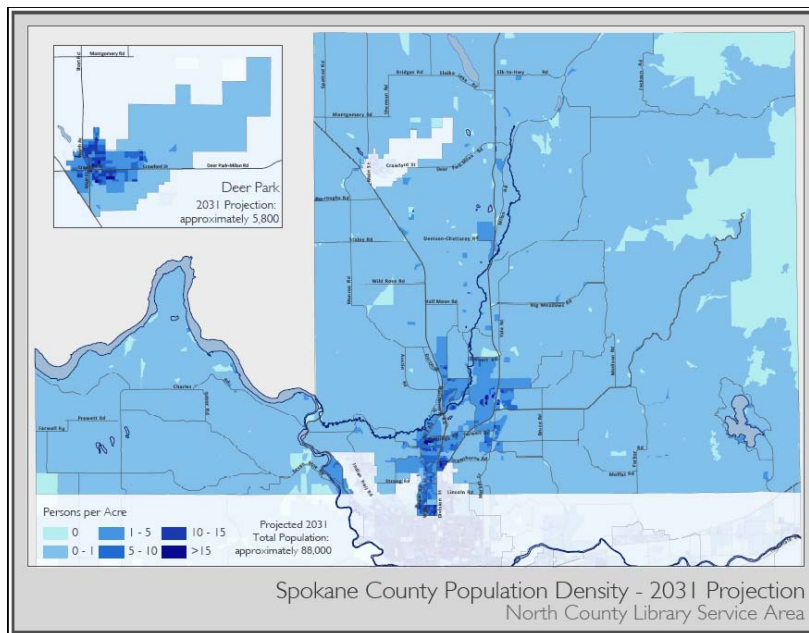
Population Estimates				
	Est. 2008	Est. 2031	Increase	% Increase
North Unincorporated Rural	44,367	50,428	6,061	13.7
North Unincorp Metro UGA/JPA	24,133	37,572	13,439	55.7
Deer Park	3,235	5,800	2,565	79.3
Total	71,735	93,800	22,065	30.8
Spokane Valley Unincorporated	36,000	42,000	6,000	16.7
Spokane Valley	88,920	108,000	19,080	21.5
Millwood	1,665	2,000	335	20.1
Total	126,585	152,000	25,415	20.1
Southwest Unincorporated	29,000	40,000	11,000	37.9
Airway Heights	5,240	6,200	960	18.3
Cheney	10,180	12,000	1,820	17.9
Medical Lake	4,810	5,100	290	6.0
Total	49,230	63,300	14,070	28.6
South Suburban	15,800	17,000	1,200	7.6
Southeast Unincorporated	5,640	10,400	4,760	84.4
Fairfield	603	875	272	45.1
Latah	194	275	81	41.8
Rockford	499	800	301	60.3
Spangle	275	675	400	145.5
Waverly	127	260	133	104.7
Total	7,338	13,285	5,947	81.0
Grand Total	270,688	339,385	68,697	25.4

POPULATION BY GEOGRAPHIC SERVICE AREA

North County

The North County, encompassing the area north of the City of Spokane to Stevens and Pend Orielle County lines and including the City of Deer Park, is projected to have a 31% population increase by 2031 to approximately 93,800 residents. Most of the increase will be along the Highway 395 and Highway 2 corridors within current and future Urban Growth Area (UGA) designations north of the City of Spokane, as shown in the population distribution map. The City of Deer Park's population is projected to increase by 79% to 5,800. Rural farmland will continue to be subdivided into 10-acre residential parcels allowed by the zoning code, adding to the rural area's population. Most of these residents travel south on Highway 2 and 395, to the Spokane area for work, shopping and entertainment.

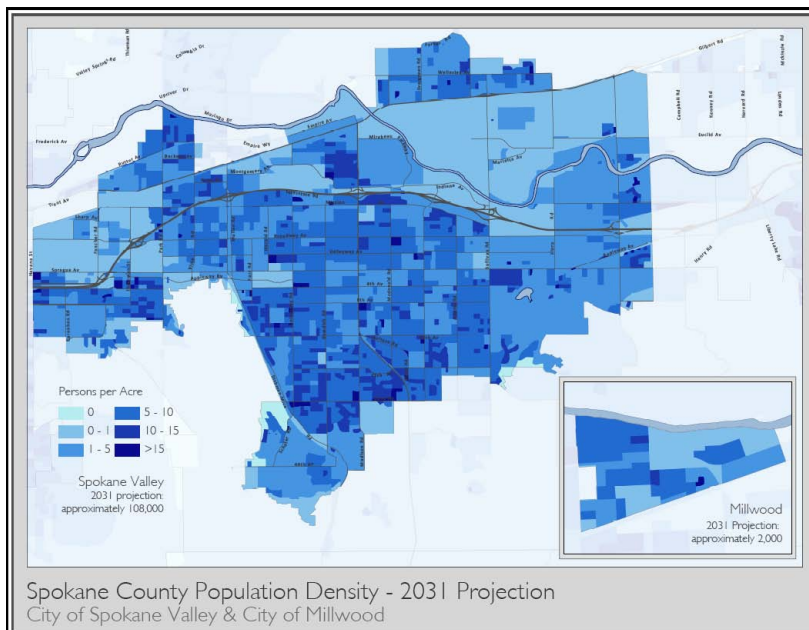
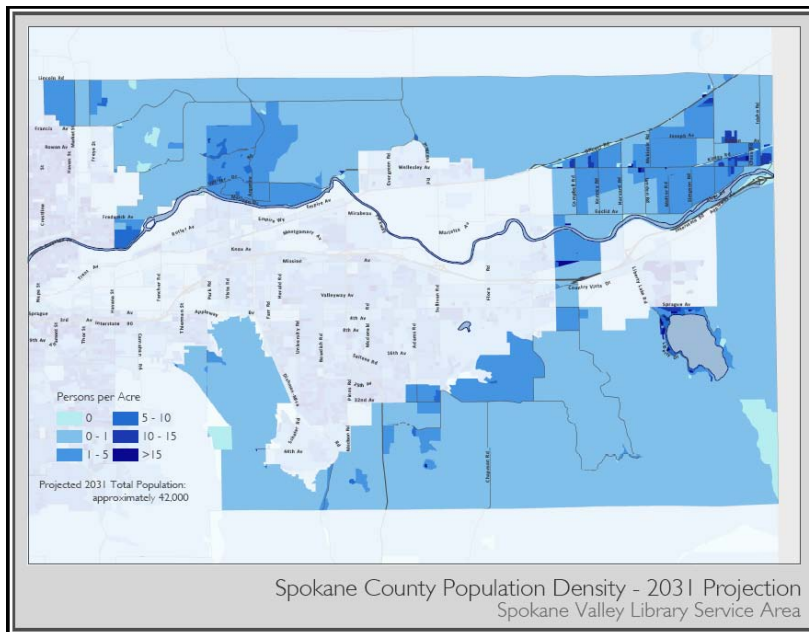
Available population figures don't adequately differentiate between areas outside the current UGA that are zoned low-density residential or urban-reserve and those with rural zoning, many of which are already developed: Anything outside the UGA is considered rural. Thus, the UGA figure doesn't represent the total urbanized area population and the rural figure is much higher than the population living in rural zoning. This makes it difficult to use population as a measure of space needs except for the north county as a whole.



Greater Spokane Valley

The greater Spokane Valley (the entire area including the Cities of Millwood and Spokane Valley but excluding the City of Liberty Lake) is projected to have a 20% population increase by 2031 to approximately 152,000. The large majority of the increase will be within the eastern and southern portions of the City of Spokane Valley, and as the population density maps indicate, the greatest concentration will ultimately be in the south-central portion on the Pines Road axis.

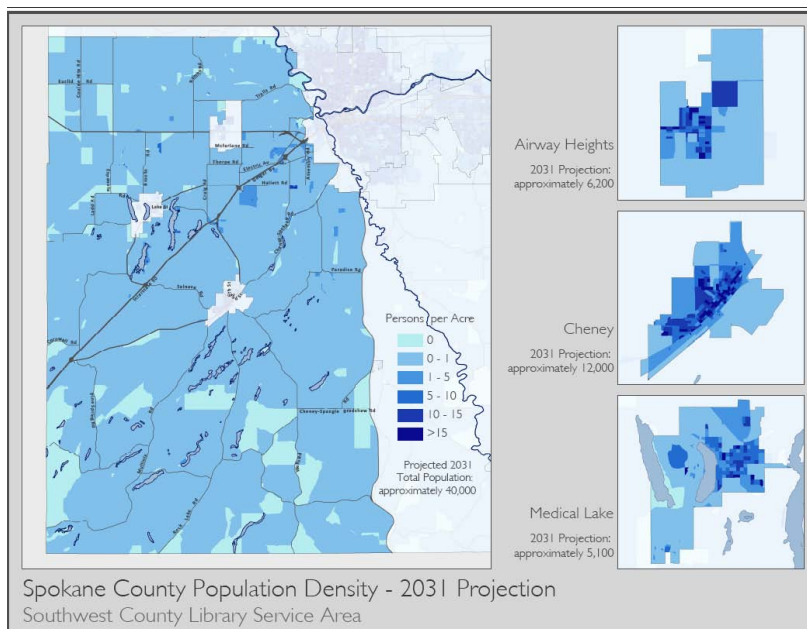
The maps also show the dispersed population distribution doesn't lend itself to branch sites convenient to most residents, yet sufficient. This is the District's most under-built service area, having only 0.30 square feet per capita of library space. To better meet those needs, a proposal to form a Library Capital Facility Area to finance the construction of a 60,000 SF main library to replace Spokane Valley Library and a 15,000 SF branch east of Sullivan Road was placed on the March 2008 election ballot. Those issues failed, at least in part over the proposed location of the main library in the controversial city-center project. Other frequent comments related to strong attachments to the current Spokane Valley Library and the desire for more neighborhood branches.



Southwest County (West Plains)

The highest anticipated 20-year Southwest County residential growth is projected to take place in its unincorporated area, with a 37.9% increase, or 11,000 people. Next is Airway Heights at 18.3% (980 people), Cheney at 17.7% (1,820 people), and Medical Lake at 6% (290 people). While there's no geographical breakdown for the unincorporated area's population increase, based on the county's current population allocation and zoning for the West Plains/Thorpe Urban Growth Area, at least half will occur in the portion of that UGA south of Interstate 90 between the Medical Lake interchange and the Spokane city limits.

The joint City of Spokane/City of Airway Heights West Plains Annexation will be effective January 1, 2012, if agreements can be finalized, includes very little of the residentially-zoned areas. However, the District's substantial property tax industrial/commercial base in the annexation area would be lost to those cities.

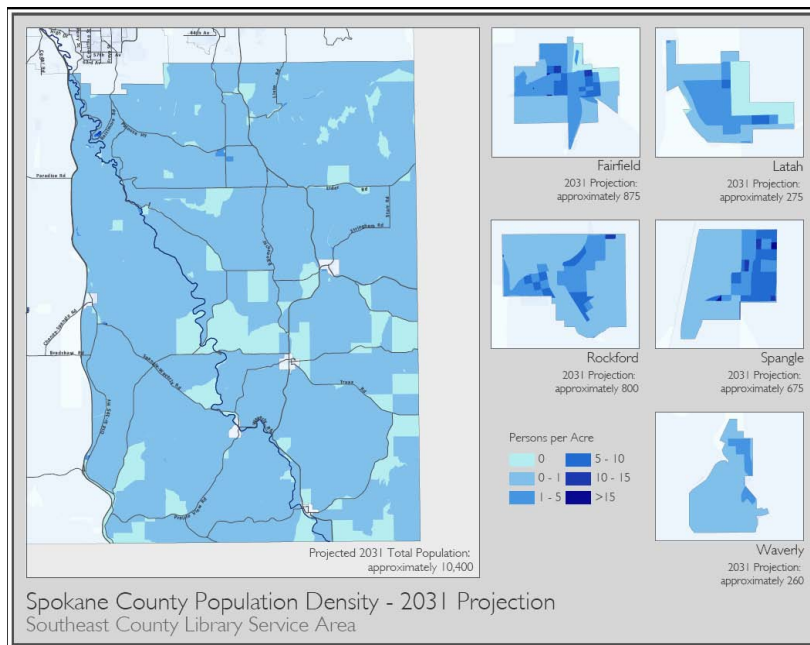


Southeast County

Southeast Spokane County is primarily an agricultural area with a very low population density. It includes the five small towns of Fairfield, Latah, Rockford, Spangle and Waverly, located far apart; Fairfield is the largest and somewhat central to the area. Due to physical geography, east-west travel is difficult. However, State Route 27 and U.S. Highway 195 run through the area in generally a north-south direction, connecting Spokane Valley and the south metro area of Spokane.

Population projections show the Southeast County to expect the highest percentage increase for the entire District.

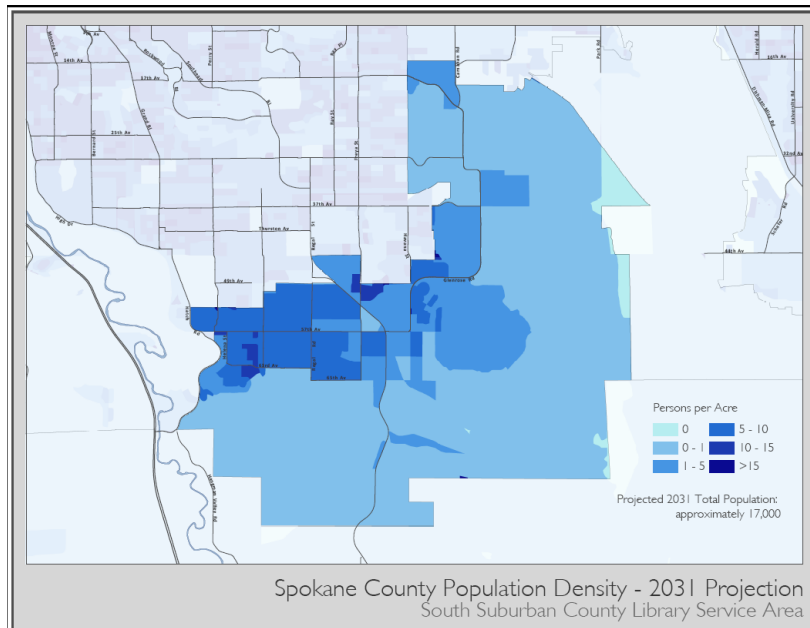
For reasons described, it is difficult to provide convenient library access to Southeast County residents, especially to those living in the northern portion closer to the Spokane metro area who have no other reason to visit Fairfield. The easiest current option is to use libraries in metro Spokane while visiting for work, shopping or other activities.



Moran and Glenrose Prairie

The Moran Prairie and Glenrose Prairie area adjacent to the southeast corner of the City of Spokane is geographically isolated from the remainder of the District. The majority of its population is within the three Urban Growth areas situated along the city limits. Except for commercial development focused on the Regal Street and 57th Avenue intersection, zoning is residential. The City of Spokane's intent is to eventually annex the UGAs, which would leave only the rural portions within the District.

The 20-year population growth estimate is 7.6%, adding another 1,200 people to the estimated 2008 population of 15,800, a relatively low growth factor.



LIBRARY SERVICE ISSUES

Collections and Shelving

At the end of 2009, District facilities housed a collection of 426,895 books and media items, which offers an average 1.69 items per capita. Historically, library industry guidelines have recommended collection sizes ranging between 2.5 and 6.0 items per capita, depending on the population size, with increasingly higher ratios for smaller populations. A library best practice for SCLD's population base is 2.5 to 3.0 items per capita.

The District's holds inter-branch delivery systems, as well as the recent move called "floating" the collection; this somewhat cushions the inadequacy of branch collections. It cannot completely compensate, however, for inadequate shelving capacity. Shelving is at or near capacity at every District library. New and popular titles cannot be displayed effectively for browsing. Needed collections cannot grow simply because there is not enough shelving space. Decisions to withdraw titles to accommodate new materials are often made on the basis of frequency of circulation rather than retrospective value, meaning that over time, collections are losing depth.

Based on best practices, collection size and shelving increases are needed to accommodate 848,463 to 1,018,155 books and media items, an increase of 99% to 139%.

Reader Seating

Seating for the public is in short supply at every facility. Space constraints force quiet reading areas to be located next to active areas for children or teens. There are ongoing conflicts between different groups of users because of noise and disruptive activity. Table seating often must be located far from collections for lack of space. Most facilities lack quiet zones or places for concentrated study. There are few acoustically enclosed group study rooms to accommodate students who need to work together on assignments, or small groups of adults that wish to meet.

Teens in particular are affected by the low seating levels. Often, this age group feels uncomfortable in both the children and the adult areas of the library. Teens who attended community meetings and focus groups commented a major reason they do not use the library in their community is for lack of a space they recognize as "their own". Adults also commented on the lack of quiet area seating.

Currently, there is customer seating for 639, or an average 2.5 seats per 1,000 service area residents. Best practices call for 3.0–4.0 reader seats per 1,000 populations. Using that guideline, 1,018 to 1,358 reader seats would be required, better enabling libraries to be organized into zones by activity, including areas conducive to quiet reading and concentrated study as well as more active spaces for children and teens. This would be an increase of 59% to 113%.

Group Study Space

Schools at every level, from elementary through college, assign group study projects on a regular basis. Students often find it difficult to locate appropriate space in which to meet and will take over reading tables at their public library for this purpose. One-on-one and small group tutoring is also increasingly popular among students, increasing demand on library seating space. Acoustically separate space is needed at almost every facility in which small groups of students, as well as the general public, can meet and work together without disturbing other library visitors.

Current group study space is minimal, with none in five of the District's 10 libraries. The most space is at Moran Prairie, with a conference room and two smaller study rooms having a total of 12 seats. Following best practices, 3–6 rooms with 18–36 seats per location is needed, for a minimum of 30 rooms and 180 seats.

Programming and Meeting Room Space

While all District libraries have meeting rooms in which library programs and activities are held, they are all undersized for the attendance at the most popular programs. At Cheney and Deer Park, for example, room capacity is often exceeded by children and caregiver attendance at storytimes. Location is a major issue at Spokane Valley, where public access is only by elevator to the basement meeting room. Children's program attendees often assemble on the main floor and are led down a non-public stairwell by staff.

The Spokane Valley and North Spokane's 100-seat meeting room capacity are the largest in the District, yet are frequently inadequate for library and community activities. Depending upon the size of the library, best practices require meeting seating for 75–200 per location.

Computers

Public-access computers are in constant use throughout the District, often with visitors waiting for a workstation to become available. The free wireless access, first implemented at Moran Prairie in 2006 and then extended to all 10 branches, is extremely popular—many customers use their own laptop computers at the library which has relieved some of the pressure on the Library's computers. This service has attracted even more library visitors, which has increased demand on seating.

To make up for the lack of dedicated computer lab training space in any facility, two portable labs with 10 laptops each are based at North Spokane and Spokane Valley for use in their regions. Classes are scheduled in library meeting rooms with the labs transported there for use. While this is an effective solution for smaller branches, resource libraries should have computers permanently located within acoustically separate areas for use in training. These spaces can be designed to allow individual customers to use the equipment whenever training is not in session.

The number of computer workstations available to the public is currently 145. To allow the District to provide adequate Internet access, word processing and other software applications, access to the Library's website and electronic information resources and eventually downloading capability, best practices call for 1.0–2.0 computers per 1,000 population. Meeting this criterion would require 339–778 public access workstations, a 134% to 437% increase.

Staff Work Space

Staff cannot work productively in undersized or inappropriate work space. Lack of space also makes it difficult to take full advantage of cost-effective technologies. In some locations, staff work space is scattered throughout the building, awkwardly configured, not acoustically enclosed or too small.

Administrative and Support Services Space

Library administrative offices and support services, with the exception of Information Technology, are co-located with the Argonne Library in the Spokane Valley. IT occupies three separated areas of the Spokane Valley Library building. These administrative and support functions occupy 12,400 square feet of space—12.1% of the District's total square footage. Support functions will need to grow to keep pace with the expanded services. For example, increased shelving will enable the District to devote more resources to the collections but Collection Services staff will need more space in which to process and distribute new materials. An overall increase of 2,600 SF would accommodate these needs and would represent only 8.3% of the recommended total 2030 square footage.

Total Facility Square Footage

Although with increasing use of technology, public libraries are more than just physical spaces, physical space (measured as number of square feet per capita) remains the primary requirement for many services, including the growing role as a community place. SCLD's current facility space in libraries totals 90,450 square feet or 0.36 per capita. With administrative and support services added, the total is 102,850 square feet or 0.41 square feet per capita.

A review of current public library standards for several states that have adopted them, indicates that 0.50 square feet per capita is a minimum, with up to 1.0 square feet being "exemplary." The best practices range is 0.60 to 1.0. On that basis, SCLD would need to provide a total of 169,693 square feet per capita at the 0.50 level, 203,631 at the 0.60 level, and 339,385—more than triple current facility space—for the 1.0 level.

FACILITY AND SITE EVALUATIONS

Evaluations were done for each facility and site by senior staff to assess how well they function. Building evaluation components were customer and public considerations; building systems; technology, staff considerations; and experiential considerations. Site evaluations included adjacencies to popular destinations; accessibility and visibility; capacity; geographic distribution; image of surroundings; and legal issues.

These evaluations indicate the wide variance in current facilities' ability to adequately support services and programs. On one end of the spectrum, the Spokane Valley Library facility was rated inadequate or poor in at least half of the evaluation areas. Besides the space issues, major building systems such as HVAC, electrical distribution and data communications are at or beyond capacity. Staff work areas are broken up and in poor locations. Acoustics and parking are poor. On the other end, Moran Prairie Library ratings were primarily good.

The facility needs for each library are briefly summarized in the Facilities Summaries section of this plan.

PUBLIC COMMENT ON DRAFT PLAN

During an April-May 2010 comment period, the community was offered several opportunities to read and comment on the March 13 plan draft and its recommendations. The plan draft was posted on the District's website and a method was provided to email comments. Late afternoon-early evening informational open houses staffed by district officials were held at a library in each of the District's four geographic regions: Spokane Valley, North Spokane, Cheney and Fairfield. Finally, letters with a copy of the draft plan were mailed to city and county officials with an invitation to provide comments on facility changes in their communities and regions.

The public comment process yielded little input. Nothing was received via the website. Total open-house attendance was 41, with 25 of that number at the Cheney event. There was only one response from a public official. Overall, the few comments that were received expressed support for the plan recommendations.



Recommendations

GUIDING PRINCIPLES

The following general policies form the basic framework from which to view the facility recommendations.

Provide library services for all

The District has a responsibility to provide library services to all its residents, including all geographic areas and all ages. However, while all residents should have access, it's not practical for everyone to have a library nearby. It also recognizes that there needs to be space and services for all ages—from children to teens, adults and seniors. Lastly, service and space recommendations should recognize the changes in library services, provide for 21st century services, and retain the flexibility to change in response to evolving needs.

Build on current strengths

The existing network of community branches and larger, full-service regional branches work well within SCLD. This network and number of branches is sustainable; improvements should be made within the existing system before considering additional facilities. The fast, efficient delivery of materials works well and should be maintained and strengthened as the need arises.

Serve as centers for technology access

Technology investment is a cost-effective way to provide information both inside libraries and remotely through the District's website. However, research studies have consistently shown that everyone doesn't have Internet access at home or at work so the libraries should continue to help bridge the digital divide for a large segment of population. In that role they should provide instruction and assistance, as well as equipment.

Serve as cultural and education center for community

The library will support community needs by offering a variety of spaces to support community services associated with its mission. Meeting rooms will be adequately-sized for the service area and group study and conference rooms will be available. Libraries will be designed to accommodate a variety of noise levels and have areas where families can use the library together. SCLD will endeavor to be welcoming and relevant to the broadest portion of community as practical.

Create libraries that are sustainable and promote efficiency

Library improvements should support efficient operations. They should use sustainably designed materials and be both energy and operationally efficient. They should be designed to reduce material handling time and allow library customers to serve themselves whenever possible. To promote efficient operations, most libraries are recommended to be single-story buildings. Sustainability also includes a reasonable expectation that there will be sufficient future revenue to adequately operate expanded facilities.

FACTORS CONSIDERED

Many factors, some competing, must be considered in planning to meet long-term library facility needs. They include the adequacy of existing facilities, the changing role of the library in the community, changing demands for services and programs, and anticipated population and demographic changes. Physical geography and routes of travel also play important rolls, as does minimum building size.

Facility and site adequacy measures for each branch and building site are summarized in the Facility Summaries section. High priorities for customers and service area residents identified in the Community Research section were more materials (especially DVDs and audiobooks), more computers, more materials and services for kids and families, better noise separation, and areas for quiet reading and study. Based in part on the changing role of the library in the community and in part of staff observations about facility use, other high priorities are more “community” spaces, such as meeting rooms, meeting room audio-visual equipment, drive-through pick up and return, parking sufficient to accommodate busy times when there are library or other programs and meetings, and more materials handling efficiency.

The role of physical geography and travel routes in facility planning is important from the aspect of siting facilities in locations that are convenient to the greatest number of people and are ideally on service area residents’ paths of travel to school, work, shopping, and entertainment. Minimum building size is the final key factor. If a library is to offer the typical range of standard services and materials, even on a small scale, there’s a square footage below which it can’t effectively function regardless of the service area population. Experience has shown that to be no less than 4,000 square feet.

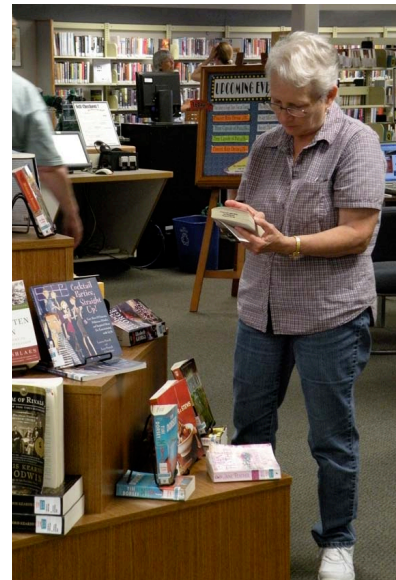
For the most part, all of the above translate to more overall physical space in varying amounts throughout the District’s service areas.

KEY RECOMMENDATIONS FOR MEETING 2030 LIBRARY SERVICE NEEDS

More space to read, learn, and gather: More than double the total library District square footage to a minimum of 0.50 overall library space per capita and a minimum of 0.50 square feet per capita in each service region. Although best practices indicate a need for 0.60–1.0 square feet per capita, current and future operation funding limitations argue for 0.50 as a more achievable goal. This plan would provide an overall 0.57 square feet per capita, including administrative and support services space.

Collections: More than double the number of books and media items, to achieve an increase from the current 1.69 items per capita to 2.63 per capita in 2030, slightly exceeding the low end best practices 2.5 items per capita.

Seating: Increase by 119%, from 2.5 seats per 1,000 service area residents to 4.1 per 1,000, slightly exceeding the high end best practices measure of 4.0.



Group study space: Triple, from 45 current seats to 132. This is well below the best practice standard in large part because of expansion limitations for existing facilities that aren't to be replaced.

Programming and meeting room space: More than double seating, from 585 currently to 1,265, and a minimum meeting room capacity of 50. The best practice for meeting rooms is 75 to 200 seats in a location. Due to expansion limitations for existing facilities, the 75 seat minimum can't be met in the District's three smallest facilities.

Public access computers: Increase from the current 145 (0.58 per 1,000 population) to 312 (0.92 per 1,000). The best practice for public access computers is 1 to 2 per 1,000 population. This is slightly below the minimum 339 required to meet the 1 per 1,000 population standard and once again reflects space expansion limitations in our smaller facilities.

Staff work space: Eliminate all undersized, scattered, awkwardly configured, or not acoustically enclosed work spaces

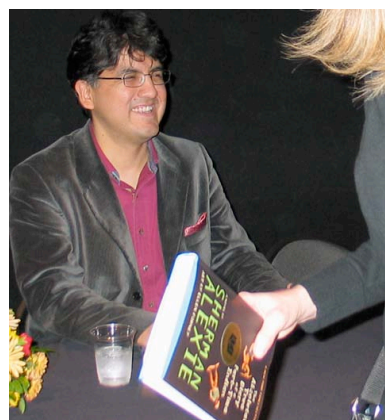
Administrative and support services space: Increase from the current 12,400 square feet of space in two separate buildings to 15,000 square feet in a single building

Convenience: For the Metro Spokane area, library facilities are located within two miles or a 15-minute drive of most residents and a 30-minute drive in rural areas

IMPLEMENTING KEY RECOMMENDATIONS

Specific facility recommendations respond to key recommendations, and projected library service needs as measured against the realities of physical geography, travel patterns and economies of scale. The 0.50 square foot per capita standard is met District-wide and in three of the five geographic regions by 2030. The two where it isn't met, in North and Southwest County, are both subject to partial future City of Spokane annexations that would reduce those populations from the 2031 estimates.

- Maintain the resource library/community library model
- Replace the Cheney, North Spokane and Spokane Valley Libraries with new facilities on different sites
- Build three new libraries: Conklin Road, South Spokane Valley and Spangle
- Expand and/or remodel the Airway Heights, Argonne, Deer Park, Fairfield, Moran Prairie and Otis Orchards libraries
- Neither remodel nor expand the Medical Lake Library
- Expand and remodel the Administrative Offices/Support Services facility



Key Recommendations: Square Footage by Service Area and Branch							
	2010 Actual		2030 Recommended				
	SF	SF/ Capital	SF	SF/ Capital	0.50 Target	Variance	Improvement
North County	26,050	0.36	42,850	0.46	46,900	-4,050	
North Spokane Library	18,850		35,000				Relocation
Deer Park Library	7,200		7,850				Addition
Spokane Valley	38,400	0.30	93,425	0.61	76,000	+17,425	
Spokane Valley Library	22,950		50,000				Relocation
Conklin Road Library	0		12,000				New branch
South Valley Library	0		12,000				New branch
Argonne Library	9,650		11,525				Expansion/Remodel
Otis Orchards Library	5,800		7,900				Expansion/Remodel
Southwest County	14,900	0.30	25,600	0.40	31,650	- 6,050	
Cheney Library	6,600		15,000				Relocation
Airway Heights Library	4,200		6,500				Expansion/Remodel
Medical Lake Library	4,100		4,100				None
Southeast County	2,700	0.37	7,500	0.56	6,643	+857	
Fairfield Library	2,700		3,500				Expansion/Remodel
Spangle Library	0		4,000				New branch
Moran/Glenrose Prairie	8,400	0.53	9,400	0.55	8,500	+900	
Moran Prairie Library	8,400		9,400				Expansion
Total	90,450	0.33	178,775	0.53	169,693	+9,082	
Admin/Support	12,400	n/a	15,000	n/a	n/a	n/a	Expansion/Remodel

Facility Component Comparison								
	2010				2030			
	Collection	Seats	Computers	Meeting Room Seats	Collection	Seats	Computers	Meeting Room Seats
Airway Heights	16,401	39	8	30	21,000	60	14	60
Argonne	42,061	79	15	50	54,000	100	22	100
Cheney	40,780	49	11	50	101,500	140	28	100
Conklin					101,000	136	30	100
Deer Park	33,116	75	13	50	37,500	100	22	100
Fairfield	9,124	25	5	30	12,000	35	8	50
Medical Lake	17,796	34	7	30	18,200	34	10	30
Moran Prairie	37,218	31	12	100	40,000	80	18	100
North Spokane	100,776	140	25	100	162,000	225	45	200
Otis Orchards	25,647	44	10	30	32,000	64	15	75
South Valley					101,000	136	30	100
Spangle					16,000	40	10	50
Spokane Valley	124,878	123	39	100	195,250	250	60	300
Total	447,797	639	145	570	891,450	1,400	312	1,365
District per capita	1.78				2.63			
District per 1,000		2.53				4.125		
District per 10,000			5.75				9.19	

LEVEL OF SERVICE (LOS)

The state's Growth Management Act, under which Spokane County is mandated to plan, requires that a county's comprehensive plan include levels of service for specific services provided by local government.

Spokane County's Comprehensive Plan states, Levels of service standards are usually quantifiable measures of the amount of public facilities or services that are provided to the community. Levels of service may also measure the quality of some public facilities. Typically, measures of levels of service are expressed as ratios of facility or service capacity to demand (i.e., actual or potential users). For example, the level of service for parks may be expressed as acres of parks for every 1,000 people. Levels of service standards are measures of the quality of life of Spokane County. The standards should be based on the community's vision of its future and its values.

Countywide Planning Policies included in the Comprehensive Plan establish regional Levels of Service for fire protection, solid-waste processing, public transit, domestic water, sanitary sewer, stormwater, street cleaning and transportation. They require local jurisdictions to establish LOS standards for schools, libraries and parks. Unlike many government services such as fire protection and transportation, there are no national standards for public libraries; their services are most effective when customized to their local community. Therefore, the selection of a reasonable quantifiable Level of Service measure is a local decision.

Implementation

FUNDING

Capital projects

There are three financing methods for library district capital projects—construction and equipping of new facilities as well as major remodeling; accumulation of normal maintenance and operations funds; short-term non-voted financing repaid from normal maintenance and operations funds; and voter-approved general obligation bonds. There are no federal or state grants or matching fund programs. Only the third option—voter-approved general obligation bonds—is feasible for anything other than a small project.

The District’s regular property tax levy, which is limited by statute in two different ways, provides only enough revenue for branch and support operations and some small-scale building improvements. There’s usually a minimal amount of excess revenue each year to place in a capital reserve fund, which is only a fraction of the amount required for construction of even one building. Non-voted General Obligation bonds, with debt service paid from current revenue isn’t feasible for the same reason. For library districts, this type of bonds is limited to a six-year term requiring annual debt service payments too high to be accommodated from revenue needed to operate an expanded library system.

Within the voter approved general obligation bonds there are two options available: one or more District-wide bond proposals or formation of individual Library Capital Facility Areas to finance projects within those geographic areas. With either, bond proceeds must be expended within five-years of bond issuance to avoid costly IRS arbitrage penalties. However, there’s no requirement the full amount of the bonds approved by voters must be issued at one time; it’s possible to stage bond issuance over a reasonable period (perhaps 10 years) to extend the time available for completing proposed projects.

District-wide ballot proposal

PRO

- Easy to place on ballot, requiring District Board of Trustees action only
- Lower overall legal and election costs per proposition since there’s only one ballot issue
- All aspects under total control of the District, resulting in easier short- and long-term administration
- Could include costs for Administrative/Support Services facility addition and remodel
- Bond sales could be phased to avoid arbitrage issues

CON

- Phased bond sale would result in higher legal and bond issuance fees
- Because of the complexity of the plan, it may not be clear to voters what they’ll get for their money and when
- Difficult to educate and inform entire service area at the same time
- Individual LCFA formation

PRO

- Tailored to service area
- Clear to voters what they’ll get for their money
- Easier to educate and inform
- Flexibility in synchronizing LCFA formation with facility needs

CON

- More complicated to place on ballot, requiring council approval for any city included within the LCFA, as well as Board of County Commissioners action to call for the election
- Complexity of process results in higher overall costs for legal fees, and the requirement for two ballot propositions (LCFA formation and bond levy approval) doubles election costs
- The legislative authority for each LCFA is the Board of County Commissioners, not the District’s Board of Trustees, making for more complicated short- and long-term administration
- Could not include costs for Administrative/Support Services facility addition and remodel

Recommended Option

A single District-wide bond issue approval with a phased bond sale would be preferable to individual LCFA. It would assure that all improvements would be made in an integrated fashion and is the only method that would provide funds for the needed Administration/Support Services space.

Operations

The District's ongoing operations are funded primarily from a maximum \$0.50 per \$1,000 of assessed value property tax that is subject to a state-mandated 1% levy lid. Because of the levy lid, the levy rate drops any time the increase in the District's total assessed value from property revaluations increases by more than 1%. The rate can be restored to \$0.50 only through a ballot proposition that requires a simple majority voter approval.

Over the past 20 years, except during the 2009–2010 economic downturn, the District's total assessed value from property revaluations has increased every year at a rate well above 1%. During the same period and with the same exception, inflation has also exceeded that amount. This situation makes periodic levy lid lifts necessary to maintain service levels, especially as library use continues to increase.

Operational Sustainability

Even with anticipated efficiencies in facility design and operations, it will cost more to maintain and operate additional and expanded buildings. No bond issue proposal for facilities should be placed before voters unless there's a reasonable expectation that additional adequate funding will be available to operate them.

To implement the proposed facility plan, it will almost assuredly be necessary to maintain the levy rate at its \$0.50 per \$1,000 maximum statutory level. This will require ongoing monitoring of changes in the District's property tax base and levy rate, realistic projections of additional revenue that may be available through periodic levy lid lifts, and voter support at the ballot box.

Facility maintenance projects

Scheduled facility maintenance can be accommodated from General Operating and Capital Reserve Funds, per the District's Fund Balance Management Policy. However, some projects could be included in a capital projects bond issue.



PROJECT COSTS

A capital budget includes much more than just construction costs so it's important to realistically plan for every component applicable to a particular project. Hard costs include land acquisition where required; demolition; renovation or new construction costs as appropriate to each project, site improvements include parking, landscaping and hardscaping; site utility allowances; furniture, fixtures and equipment (FF&E); library shelving, new library materials that are required, signage, technology infrastructure and equipment.

Soft costs include design and engineering, project management and construction management, plan check, inspections and permits.

They might also include community input meetings and public communications, legal fees, bond sale fees, as well as sustainable design certification and energy efficiency commissioning costs. Also, state and local sales taxes must be paid on construction costs, new library materials and FF&E.

Finally, project budgets must include contingencies and a cost escalation factor keyed to the anticipated mid-point of construction.

Estimating methodology

The construction costs estimates were developed by the District's consultants, Integrus Architecture and Roen Associates, who have cost estimating experience with both construction and renovation of similarly sized branch libraries. The \$210 per square foot for new construction and \$160 per square foot are based costs for building, landscape, and parking appropriate to public buildings of the size and type proposed and assume the traditional Washington public works project design/bid/build process.

All construction costs are 2010 dollars and include a 5% contingency. Escalation factors must be determined for each facility prior to seeking public funding to assure that the budget is realistic for the time period it will actually be built. Design fees use the Washington State Architectural/Engineering Guidelines.

Furniture budgets are based on square foot costs and are for new items to replace and augment existing furniture. Library materials budgets include both purchase and processing costs. Following District policy, each budget includes one-half of one percent for public art.

Project Costs			
	SF: New	SF: Remodel	Total Cost
North County			
Replace North Spokane Library	35,000	0	12,470,000
Deer Park Library: Addition	650	0	204,000
Totals	35,650	0	12,674,000
Spokane Valley			
Replace Spokane Valley Library	50,000	0	15,563,000
New Conklin Road Library	12,000	0	5,101,000
New South Valley Library	12,000	0	5,104,000
Argonne Library: Addition & Remodel	1,875	2,000	983,000
Otis Orchards Library: Addn & Remodel	2,100	600	756,000
Totals	77,975	2,600	27,507,000
Southwest County			
Replace Cheney Library	15,000	0	4,961,000
Airway Heights Library: Addn & Remodel	2,300	600	819,000
Totals	17,300	600	5,780,000
Southeast County			
Fairfield Library: Addition & Remodel	800	600	387,000
New Spangle Library	4,000	0	1,475,000
Totals	4,800	600	1,862,000
South Suburban			
Moran Prairie Library: Addition	0	1,000	318,000
Administration/Support Services			
Addition & Remodel	4,300	7,000	2,660,000
Grand Total	140,025	11,800	50,801,000

PRIORITIES

To meet service area facility needs through 2030, all recommendations should be implemented and all facility improvements completed no later than that date. However, some current individual facility deficiencies are greater than others and some service areas have more critical current square footage deficiencies. Facility improvements are therefore grouped on the basis of a combination of current needs and anticipated future service area population increases.

The highest priority is in the City of Spokane Valley, which has the greatest overall space deficit and has the most inadequate facility—Spokane Valley Library. The Administration/Support Services addition and remodel is next for two reasons: first, a location is needed for IT department relocation when the existing facility is vacated and, second, space will be needed for the increased behind-the-scenes operations required to support expanded and additional libraries.

The first column below shows the priority groupings based on current needs and a response to future population growth. The second column indicates proposed phasing for a single, District-wide bond proposal but three separate bond sales over a seven-year period.

For purposes of illustration, it assumes an early 2013 ballot issue approval.

Priority Groups

Priority Group 1

- Spokane Valley Library replacement
- Administration/Support Services addition/remodel

Priority Group 2

- Conklin Road library construction
- Cheney Library replacement
- Airway Heights Library addition/remodel

Priority Group 3

- Spangle Library construction
- South Valley Library construction

Priority Group 4

- North Spokane Library replacement
- Fairfield Library addition/remodel

Priority Group 5

- Argonne Library addition/remodel
- Otis Orchards Library addition/remodel
- Deer Park Library addition
- Moran Prairie Library addition

Project and Bond Sale Phasing

Phase 1: 2013–2016

Design, construction, and opening

- Spokane Valley Library replacement
- Administration/Support Services addition/remodel

Bond sale: Early 2014

Phase 2: 2015–2020

Design, construction, and opening

- New Conklin Road Library
- Cheney Library replacement
- Airway Heights Library addition & remodel
- New Spangle Library
- New South Valley Library

Bond sale: Early 2016

Phase 3: 2019–2024

Design, construction, and opening

- North Spokane Library replacement
- Fairfield Library addition/remodel
- Argonne Library addition/remodel
- Otis Orchards Library addition/remodel
- Deer Park Library addition/remodel
- Moran Prairie Library addition

Bond sale: Early 2020

Facility Summaries: North County

NORTH SPOKANE LIBRARY PROFILE

Built: 1972

Expanded: 1990

Remodeled: 1990

Building ownership: Spokane County Library District

Site ownership: Spokane County Library District

Size: 18,850 SF

	2009	5-year % change
Weekly hours open	64	18.5%
Annual visits	312,853	28.3%
Visits per open hour	94	8.0%
Visits per square foot	17	30.8%
Annual circulation	550,925	13.9%
Circulation per open hour	166	-3.5%
Circulation per square foot	29	11.5%
Annual computer bookings	64,711	18.4%

North Spokane Library's primary service area is the relatively narrow Y-shaped urbanized area stretching from Francis Avenue on the south to Hatch Road on the northwest and Day-Mount Spokane Road on the northeast. It also serves as the resource library for the North County rural area. Besides District residents, it is heavily used by reciprocal agreement as the library nearest City of Spokane residents living east of Division Street and north of Francis Avenue. The building is attractive and well-maintained.

Library Needs

The existing North Spokane Library is adequate for its current service area population but not for the growth anticipated over the next 20 years. Continued strong population growth is anticipated within the North Spokane UGA, primarily to the miles north and northeast and with possible inclusion of additional land east of Highway 2 in the UGA, there'll be yet more development. At the same time, the long and narrow south end of the service area is subject to potential City of Spokane annexation, up to and including the site of the North Spokane Library.

The site isn't large enough for another building expansion thus another facility will be needed in the future.

The District owns a 4+ acre site on Hastings Road on the crossroads between US 2 and US 395, central to the northern portion of the Urban Growth Area and just west of the new North Spokane Corridor Farwell Road interchange. It's approximately two miles north of the North Spokane Library and 15 miles south of the Deer Park Library. It's surrounded by single-family residential development.

The large Wandermere commercial center is approximately one mile west. An elementary and middle-school are within a half-mile, and Mead High School is a little over a mile away. The nearest public transit is approximately one mile east at Wandermere.



Recommendations

- Replace the existing North Spokane Library with a new 32,000 square foot building on the Hastings Road site
- Sell the existing building after the new facility opens

Component	Existing	Recommended
Collection	100,776	162,000
Computers	25	45
Seating		
Library	140	225
Meeting room	1 w/100 seats	2 w/100 seats ea
Conference	1 w/8 seats	1 w/8 seats
Quiet study	0	4 w/2 seats ea
Building size	18,838	32,000



Potential Site Area: approx. 4 acres

■ Potential Building Area: 35,000 SF

Implementation

A new North Spokane Library is in Priority Group 4 and Phase 3, with design proposed for 2019 and the new library opening in 2021. It's in a lower priority grouping because there are other more pressing facility needs in the District. In addition, in the future there may be action UGA boundary expansion and on any City of Spokane annexations by this time, providing more certainty regarding the library's service area.

Prior to proceeding with development, a needs assessment specific to this service area and a detailed building program should be prepared by experienced professionals. These should be undertaken as part of a focused pre-design study establishing project requirements, budget, and schedule in detail.

DEER PARK LIBRARY PROFILE

Built: 1998

Building ownership: Spokane County Library District

Expanded: n/a

Site ownership: Spokane County Library District

Remodeled: n/a

Size: 7,200 SF

	2009	5-year % change
Weekly hours open	58	38.1%
Annual visits	163,945	78.3%
Visits per open hour	54	28.6%
Visits per square foot	23	76.9%
Annual circulation	150,892	15.3%
Circulation per open hour	50	-16.7%
Circulation per square foot	21	16.7%
Annual computer bookings	23,330	77.9%



The Deer Park Library's service area is the northern tier of the county, including the Riverside and Elk areas. On Highway 395, Deer Park is about 6 miles west of the Riverside area and approximately a 20-minute drive from North Spokane Library. While the library isn't adjacent to a commercial area or on a heavily-traveled arterial street, it's near most Deer Park schools and a medical clinic. The setting is very pleasant with nice views and the building is attractive and well-maintained. Deer Park Library meets the needs of the current population. Because most of its customers travel to the Spokane area for work, shopping, and entertainment, North Spokane Library's location provides them with a convenient back-up.

Library Needs

The Deer Park Library will continue to meet most of its service area's future needs as its relatively modest population growth can be accommodated within the current square footage. Some increase in collection size and the number of computers, two service components that will see some stress, is possible through space reallocation. The greatest need is for a meeting room that can accommodate larger library program and community groups. The site and building orientation is such that the only feasible expansion is a small addition on the Forest Avenue (children's area) end of the existing building.

Recommendations

- Add approximately 650 square feet, the maximum possible, to the east end of the building to allow a meeting room expansion
- Reconfigure existing space to allow a modest collection expansion and additional computers

Component	Existing	Recommended
Collection	33,116	37,500
Computers	13	22
Seating		
Library	75	100
Meeting room	1 w/50 seats	1 w/100 seats
Conference	1 w/8 seats	1 w/8 seats
Quiet study	0	0
Building size	7,200	7,850

Implementation

The Deer Park Library addition is in Priority Group 5 and Phase 3, with design proposed for 2022 and completion in 2023. The lower priority grouping reflects other more pressing facility needs in the District as well as its relatively low impact.



Facility Summaries: Spokane Valley

SPOKANE VALLEY LIBRARY PROFILE

Built: 1955

Expanded: 1986

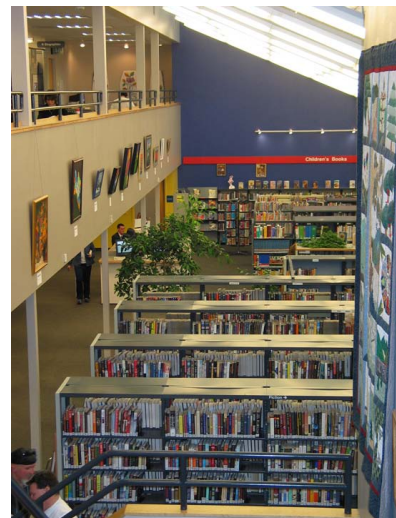
Remodeled: 1986 & 1988

Building ownership: Spokane County Library District

Site ownership: Spokane County Library District

Size: 24,650 SF (22,950 SF library; 1,700 SF IT)

	2009	5-year % change
Weekly hours open	64	18.5%
Annual visits	318,049	26.3%
Visits per open hour	96	6.7%
Visits per square foot	13	30.0%
Annual circulation	585,365	13.4%
Circulation per open hour	161	-12.5%
Circulation per square foot	24	14.3%
Annual computer bookings	80,355	32.6%



Spokane Valley Library doesn't have adequate space for either customers or staff and the building systems (electrical and HVAC) are stretched to their limits or beyond during extreme conditions. Noise management is an issue. While every attempt has been made to make the building as attractive as possible, it's by necessity crowded. Public restrooms are too small. Access to the basement meeting room is difficult and there isn't enough meeting, conference room or study room space to meet needs. While the location is central and only one block from Spokane Valley's busiest intersection and from public transit, parking is inadequate and the size of the site doesn't allow for either building or parking expansion.

Library needs

The cost to totally renovate Spokane Valley Library is about 80% of the cost of the same amount of new space, yet most of its major deficiencies would remain. It would be closed for up to a year, requiring either a temporary location or completion of the other branches prior to its closing; materials, furniture and equipment storage might be necessary. Therefore, a new and larger Spokane Valley Library is the most practical alternative for providing the space needed to serve as the region's resource library. It would provide economies of scale for staffing and library materials, central community space, larger meeting rooms and adequate parking. Because the existing library would remain open during construction, this option would provide customers with uninterrupted services except for the time needed to move from the old to the new building.

Recommendations

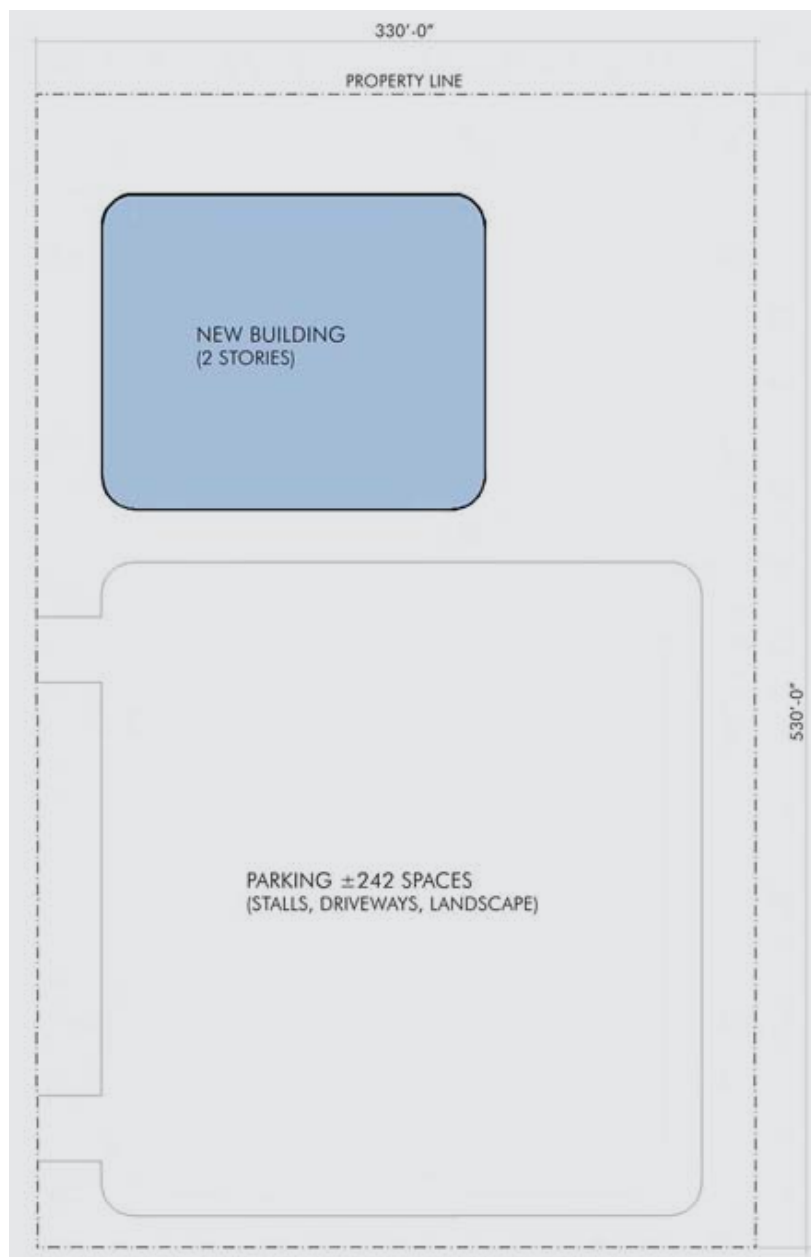
- Replace the existing Spokane Valley Library with a new building of at least 50,000 square feet in the central Valley on the Sprague Avenue corridor axis between University and Evergreen Roads
- Sell the existing building after the new facility opens

Component	Existing	Recommended
Collection	124,878	195,250
Computers	39	60
Seating		
Library	123	250
Auditorium	0	200
Meeting room	100	100
Conference	1 w/8 seats	2 w/10 seats each
Quiet study	1 w/1 seats	5 w/2 seats each
Building size	22,950	50,000

Implementation

A new Spokane Valley Library is Priority Group 1 and Phase 1, with design proposed for 2013 and the new library opening in 2016. The high priority reflects the existing building's deficiencies and the insufficiency of library facilities serving the greater Spokane Valley area.

The building program and pre-design study completed in 2007 for a slightly larger facility should be reviewed and updated for this new project. Because of the anticipated difficulty in procuring a suitable 4-acre site, the process of identification and obtaining a purchase option should begin as soon as possible.



CONKLIN ROAD LIBRARY SITE PROFILE

Region: Greater Spokane Valley

Size: Approximately 2 acres

Address:

Ownership: Spokane County Library District

Purchased: 2007

The two-acre Conklin Road site was purchased as the location for a new library branch to serve Veradale and Greenacres in the southeastern portion of the City of Spokane Valley. It's a half-block south of Sprague Avenue at a signalized intersection in a commercially-zoned area. The south property line is the former Milwaukee Road Railroad right-of-way, planned to eventually be used for an extension of Appleway Boulevard and possible light rail or other mass transit. Except for the Sprague Avenue and nearby Sullivan Road corridors, the entire service area is residential. The land is commercially zoned.

Library Needs

The services-area residents do not have convenient access to a library. It is from two to four miles east of Spokane Valley Library and six to eight miles southwest of Otis Orchards Library. Six public and private elementary and middle schools, as well as Central Valley High School are within about a one-mile radius.

Recommendations

Build an approximate 12,000 square foot neighborhood library on the site.

Component	Recommended
Collection	101,000
Computers	30
Seating	
Library	136
Meeting room	1 w/100 seats
Conference	1 w/8 seats
Quiet study	2 w/2 seats each
Building size	12,000 SF

Implementation

A new Conklin Road Library is in Priority Group 2 and Phase 2, with design proposed for 2015 and the new library opening in 2017. It's in a higher priority grouping because the area is currently unserved and because of Spokane Valley's overall space deficiency.

Prior to development, a detailed building program should be prepared as part of a focused pre-design study setting out project requirements, budget and schedule in detail.



Potential Site Area: approx. 2 acres

■ Potential Building Area: 12,000 SF

SOUTH SPOKANE VALLEY LIBRARY NEEDS

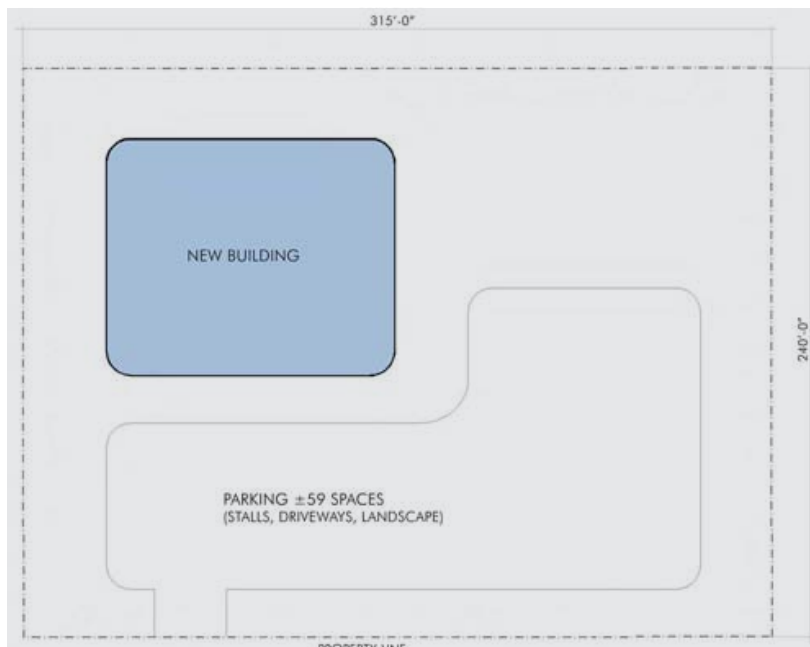
The South Spokane Valley area would be served by a 15,000 square foot branch. This area is primarily residential, with neighborhood commercial development at some major intersections. University High School, three middle schools, and eight elementary schools are located there.

The District owns no building sites in South Valley. The biggest challenge to purchasing suitable property will be the high degree of development that's already taken place, making it difficult to find two acres of land in an appropriate location with visibility from a major street. This is of most concern if only one library is to be built, as it would be best located near the Pines Road and 32nd Avenue intersection, which has no vacant or under-utilized land of that size. There are more options available east toward or beyond SR 27 and west to Dishman-Mica Road.

Recommendations

Build an approximate 12,000 square foot neighborhood library on the site.

Component	Recommended
Collection	101,000
Computers	30
Seating	
Library	136
Meeting room	1 w/100 seats
Conference	1 w/8 seats
Quiet study	2 w/2 seats each
Building size	12,000 SF



Potential Site Area: approx. 1.75 acre

■ Potential Building Area: 12,000 SF

Implementation

A new South Spokane Valley Library is in Priority Group 3 and the end of Phase 2, with design proposed for 2018 and the new library opening in 2020. Although this area is currently unserved, much of it will be within a 15-20 minute drive of the new Spokane Valley Library's location, placing it slightly lower on the overall District priority scale.

Prior to development, a site must be acquired and a detailed building program should be prepared as part of a focused pre-design study setting out project requirements, budget and schedule in detail.

ARGONNE LIBRARY PROFILE

Built: 1990

Expanded: n/a

Remodeled: 2005

Size: 9,650 SF

Building ownership: Spokane County Library District

Site ownership: Spokane County Library District

Building shared with Administrations/Support Services

	2009	5-year % change
Weekly hours open	54	35.0%
Annual visits	98,596	27.1%
Visits per open hour	35	-5.4%
Visits per square foot	15	25.0%
Annual circulation	163,635	36.4%
Circulation per open hour	59	-1.7%
Circulation per square foot	25	38.9%
Annual computer bookings	25,085	78.2%



Argonne Library is located at the intersection of a major and minor arterial, Argonne Road and Upriver Drive. It serves the West Valley, although its location at its northern edge makes Spokane Valley Library a more convenient library option for residents south of Interstate 90. Being on the major north-south route between the North County and Spokane Valley, a significant portion of its use is from commuters living elsewhere. It's also relatively easily accessed from Trentwood, a City of Spokane Valley residential area east on Upriver Drive and Wellesley Avenue that's separated by industrial and commercial development from the remainder of the city. The building is attractive and well-maintained, with the interior recently updated.

Library needs

Although Argonne Library more than adequately meets customer needs in most areas, space is needed for additional computers, seating (particularly adult), quiet study rooms, and a meeting room expansion. Parking is generally sufficient, with the staff parking in the rear available outside normal office hours.

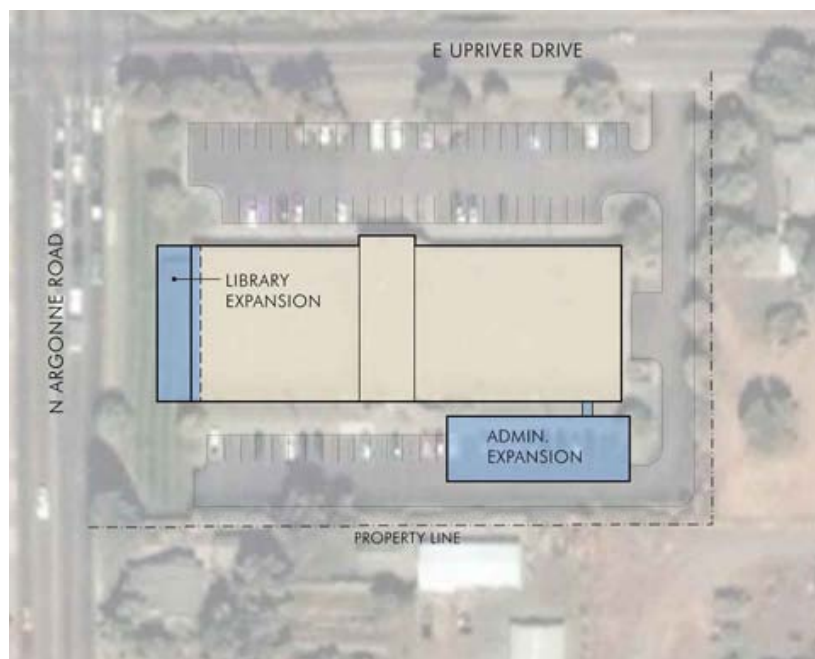
Recommendations

- Construct an 1,875 SF addition to the west end of the library to provide additional computer workstations, seating, and a quiet study room
- Remodel the east end of the library to double the size of the meeting room and possibly reconfigure the entry area

Component	Existing	Recommended
Collection	42,061	54,000
Computers	15	22
Seating		
Library	79	100
Meeting room	1 w/50 seats	1 w/100 seats
Conference	1 w/8 seats	1 w/8 seats
Quiet study	0	1 w/2 seats
Building size	9,650 SF	11,525 SF

Implementation

The Argonne Library expansion and remodel is in Priority Group 5 and Phase 3, with design proposed for 2020 and completion in 2021. The lower priority reflects the current overall adequacy of the existing facility and the fact that Spokane Valley area's facility space deficiency will have largely been met.



- Existing Building: approx. 18,400
- Potential Expansion- Library: approx. 1875
Admin.: approx. 4300
Remodel- Library: 2000
Admin.: 7000

OTIS ORCHARDS LIBRARY PROFILE

Built: 1991

Building ownership: Spokane County Library District

Expanded: n/a

Site ownership: Spokane County Library District

Remodeled: n/a

Size: 5,800 SF

	2009	5-year % change
Weekly hours open	36	0.0%
Annual visits	56,197	17.7%
Visits per open hour	30	15.4%
Visits per square foot	10	25.0%
Annual circulation	88,921	-8.2%
Circulation per open hour	48	-7.7%
Circulation per square foot	15	-6.3%
Annual computer bookings	7,682	-9.8%



Otis Orchards Library serves the Spokane Valley's northeast residential area, including East Farms and Newman Lake. The entire area is within East Valley School district, with two elementary and a middle school located in general neighborhood. One of them, Otis Orchards Elementary, is just west of the library. The schools, the next-door fire station and the library are the area's only public facilities. There is little commercial development.

Formerly a fast-growing area, its exclusion from an Urban Growth Area with the county's Growth Management Act (GMA) implementation, and its exclusion from sewer extension plans, severely limits its growth potential. Most of the library's service area has a rural zoning classification requiring five-acre lots, except for property platted prior to GMA.

Library Needs

The building is attractive and well-maintained and for the most part meets the needs of its service area residents. However, because of the distance from other larger District libraries and the lack of public transit to them, a larger materials collection is needed. As with all libraries, there's a demand for more computers. The meeting room is undersized for its library program needs. Parking can be tight during programs.

Recommendations

- Expand the library by approximately 2,100 square feet to accommodate additional materials, computers and to free space for a meeting room expansion
- Remodel the interior to increase the size of the meeting room
- Expand the parking area

Component	Existing	Recommended
Collection	25,647	32,000
Computers	10	15
Seating		
Seating: Library	44	64
Meeting room	1 w/30 seats	1 w/75 seats
Conference	0	1 w/8 seats
Quiet study	0	1 w/2 seats
Building size	5,800 SF	7,900 SF

Implementation

The Otis Orchards Library expansion and remodel is in Priority Group 5 and Phase 3, with design proposed for 2021 and completion in 2022. The lower priority reflects the current overall adequacy of the existing facility and the fact that the Spokane Valley area's facility space deficiency will have already been largely met.



Facility Summaries: Southwest County

CHENEY LIBRARY PROFILE

Built: 1988	Building ownership: City of Cheney
Expanded: 1997	Site ownership: City of Cheney
Remodeled: 1997	Size: 6,600 SF

	2009	5-year % change
Weekly hours open	58	20.8%
Annual visits	127,223	53.7%
Visits per open hour	42	27.3%
Visits per square foot	19	46.2%
Annual circulation	163,735	9.9%
Circulation per open hour	54	-10.0%
Circulation per square foot	25	8.7%
Annual computer bookings	20,235	20.2%

Cheney Library serves as the sub-resource library for the entire West Plains area as well as the community's local library. It's located on the main street of downtown Cheney adjacent to city hall, central to the older section of the city but relatively distant from newer residential areas to the northwest. There are three elementary schools, a middle school and a high school in the city, none of them near the library. It was expanded in 1997 with the addition of the children's room and space reconfiguration in the existing building. However, with the change in its role from community library to resource library, increased use, and space requirements for public computers, the facility is now overcrowded and inadequate to meet service area needs. Even if another expansion was feasible, the site can't accommodate a larger building footprint and additional parking.

Library Needs

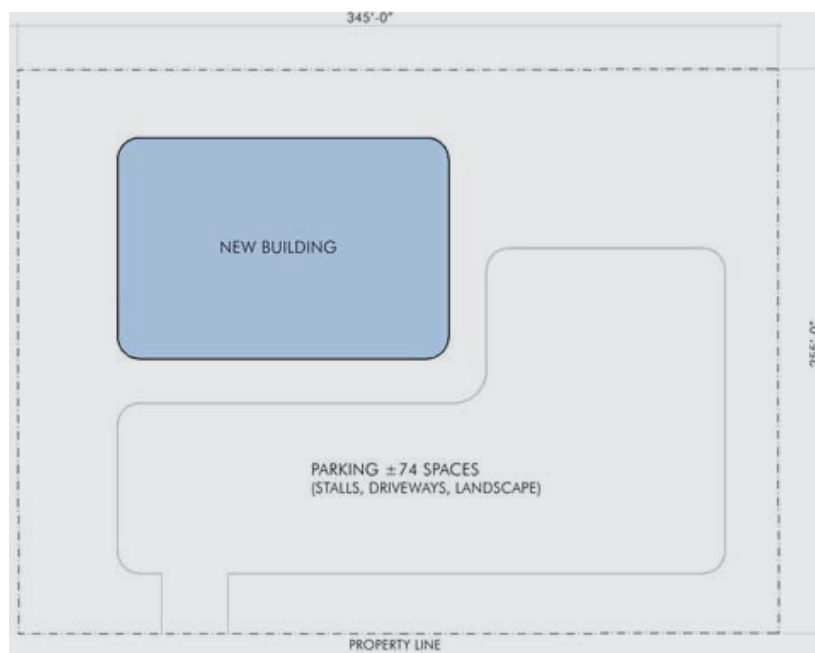
The building is already inadequate in virtually every way to meet local and area library service needs—materials shelving space, seating, public computers, restroom facilities, meeting room size and alternative small group space, parking, storage and functional staff work area. The area's population increase will further exacerbate the situation. The only realistic alternative is to replace the current facility with a much larger new building on a new site, with the City of Cheney using the vacated building for another community purpose. For access and visibility, a site on or adjacent to First Street as near as possible to the downtown area is preferable.



Recommendations

- Build a new approximate 15,000 square foot resource library
- Convert the existing building to another City of Cheney's use

Component	Existing	Recommended
Collection	40,780	101,500
Computers	11	28
Seating		
Seating: Library	49	140
Meeting room	1 w/50 seats	1 w/100 seats
Conference	0	1 w/8 seats
Quiet study	0	2 w/2 seats each
Building size	6,600	15,000



Potential Site Area: approx. 2 acres
 ■ Potential Building Area: 15,000 SF
 Approx. Construction Cost (at \$210/SF): \$3,150,000

Implementation

Cheney Library's replacement is in Priority Group 2 and Phase 2, with design proposed for 2015 and the new library opening in 2017. The relatively high priority reflects the existing building deficiencies and the insufficiency of library facilities serving the Southwest County area.

Prior to development, a site must be acquired and a detailed building program should be prepared as part of a focused pre-design study setting out project requirements, budget and schedule in detail.

AIRWAY HEIGHTS LIBRARY PROFILE

Built: 1997

Building ownership: Spokane County Library District

Expanded: n/a

Site ownership: City of Airway Heights

Remodeled: n/a

Size: 4,200 SF

	2009	5-year % change
Weekly hours open	28	12.0%
Annual visits	51,316	126.3%
Visits per open hour	35	105.9%
Visits per square foot	12	140.0%
Annual circulation	54,068	40.2%
Circulation per open hour	37	23.3%
Circulation per square foot	13	44.4%
Annual computer bookings	7,781	70.0%



Airway Heights Library primarily serves the Highway 2 corridor and Southwest County north of Highway 2. Some residents of Fairchild Air Force Base, located west of the city, also use the library even though the base has a library. It's located two blocks north of Highway 2, adjacent to the community center and across the street from City Hall and the fire station. There is public transit to and from Spokane and Fairchild on Highway 2. The city's elementary school is located two blocks east; middle- and high-school students are bused to Cheney. The building is attractive and well-maintained. It was designed for an addition to the east side that could increase space by almost half.

Library Needs

The community has experienced considerable growth since the Airway Heights Library was opened, and that growth is projected to continue. During that time library use has also continued to increase, particularly in use of public computers and wireless access. The greatest current needs are for more seating, more computers, a larger materials collection, and a meeting room that can better accommodate large groups attending library children's programs. Parking can also be an issue. While an expansion of open hours might alleviate some of these problems in the short-term, a larger building is an effective long-term solution.

Recommendations

- Build an approximate 2,300 SF addition to increase the library's public area
- Reallocate interior space to double the size of the meeting room

Component	Existing	Recommended
Collection	16,401	21,000
Computers	8	14
Seating		
Library	39	60
Meeting room	1 w/30 seats	1 w/60 seats
Conference	0	1 w/8 seats
Quiet study	0	2 w/2 seats each
Building size	4,200 SF	6,500 SF

Implementation

The Airway Heights Library addition and remodel is in Priority Group 2 and mid-Phase 2, with design proposed for 2016 and completion in 2017. The relatively high priority reflects the existing building deficiencies and the insufficiency of library facilities serving the Southwest County area.



MEDICAL LAKE LIBRARY PROFILE

Built: 1997 Building ownership: City of Medical Lake
 Expanded: n/a Site ownership: City of Medical Lake
 Remodeled: n/a Size: 4,100 SF

	2009	5-year % change
Weekly hours open	28	12.0%
Annual visits	54,980	132.4%
Visits per open hour	38	111.1%
Visits per square foot	13	116.7%
Annual circulation	53,784	36.0%
Circulation per open hour	37	23.3%
Circulation per square foot	12	33.3%
Annual computer bookings	6,021	49.3%

Medical Lake Library is centrally located in the older portion of the city adjacent to the post office but two blocks from any main streets. Two elementary schools, a middle and high school are within a half mile. The building is attractive and well-maintained. There is adequate parking. Because of building design and site size, there is little room for expansion.

Library Needs

The library meets the needs of its service area in most respects. The only significant shortfall is the meeting room, which is too small to accommodate many of the library's children's programs and some community uses. Minor needs are for more materials and computers. There have also been problems with HVAC system effectiveness.

Recommendations

- Reallocate space to allow for a modest increase in collection size and the addition of three computers
- Determine options for upgrading the HVAC system

Component	Existing	Recommended
Collection	17,796	18,200
Computers	7	10
Seating		
Library	34	34
Meeting room	1 w/30 seats	1 w/30 seats
Conference	0	0
Quiet study	0	0
Building size	4,100 SF	4,100 SF

Implementation

The identified improvements can be done at any time.



Facility Summaries: Southeast County

FAIRFIELD LIBRARY PROFILE

Built: 1968	Building ownership: Town of Fairfield
Expanded: 1999	Site ownership: Town of Fairfield
Remodeled: 1999	Size: 2,700 SF

	2009	5-year % change
Weekly hours open	26	30.0%
Annual visits	23,806	126.9%
Visits per open hour	18	80.0%
Visits per square foot	9	125.0%
Annual circulation	21,141	30.8%
Circulation per open hour	16	0.0%
Circulation per square foot	8	33.3%
Annual computer bookings	4,411	125.6%

The Fairfield Library is located on the town's main street, on the east side of its small commercial area. The Southeast Spokane County Historical Society and Museum is next door, a community center is across the street, and the town hall is in the next block. There are no schools in Fairfield. The facility is modest but well-maintained. The 1999 addition and renovation was the first alteration to the building since its opening in 1968. The building footprint extends to the property line on each side and to the front setback requirement, making future expansion possible only to the rear.

Library Needs

Because of its small size and layout, the facility has a number of significant inadequacies, to include teen collection size, availability of study areas, sightlines, and space availability for computers and other technology. The meeting room, which has minimal community use, is located at the front of the building to accommodate after-hours access, consuming prime space that could be otherwise used more effectively. Since it is used almost exclusively for library programs, the need for after hours access is infrequent.



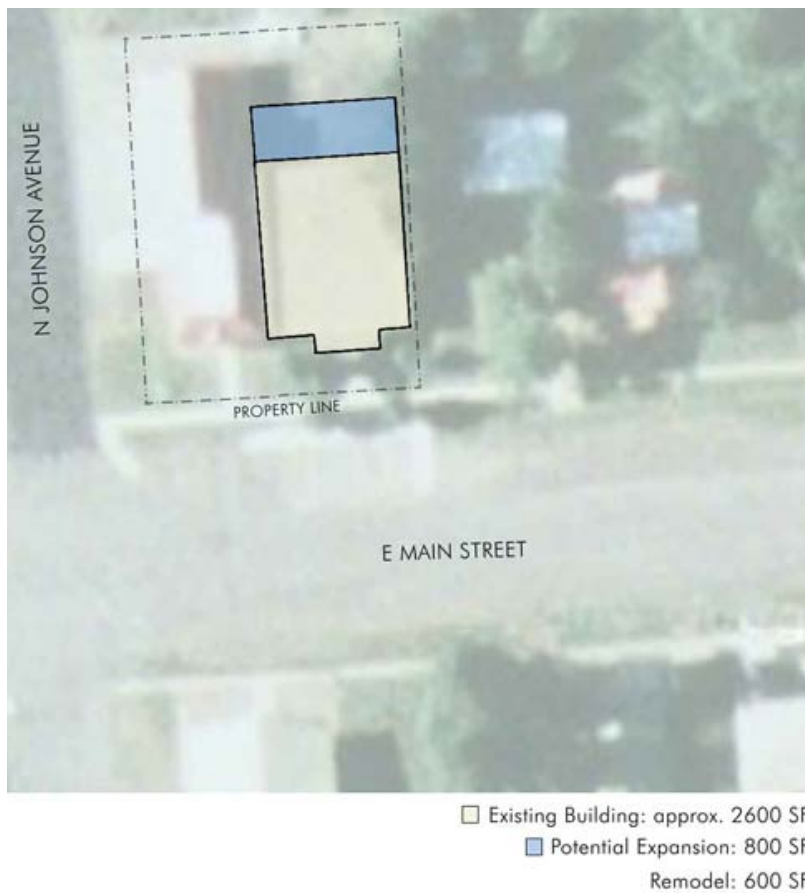
Recommendations

- Build an approximate 800 SF addition to the rear of the building
- If community use of the meeting room remains minimal at the time the addition is planned, convert the current meeting room to public service space and reconfigure the interior space.

Component	Existing	Recommended
Collection	9,124	12,000
Computers	5	8
Seating		
Library	25	35
Meeting room	1 w/30 seats	1 w/50 seats
Conference	0	0
Quiet study	0	1 w/2 seats
Building size	2,700 SF	3,500 SF

Implementation

The Fairfield Library addition and remodel is in Priority Group 2 and early in Phase 3, with design proposed for 2020 and completion in 2021. The lower priority level recognizes the prior opening of the new Spangle Library and the relatively small population that would be served by the project.



SPANGLE AREA LIBRARY NEEDS

Due to the Southeast County's physical geography, travel patterns, and spread-out population, the Fairfield Library isn't convenient to residents on its western side in Spangle, and the U.S.195 corridor, even though they are located in the same school district. The same holds true for Cheney, located west of the area and accessible only by rural roads. These factors create need for a District library in Spangle to serve the town and US 195 corridor between the Whitman County line and metro Spokane. Given previous experience with other small library space deficiencies, 4,000 square feet is the smallest practical size for a facility that includes a small meeting/program room.

Recommendation

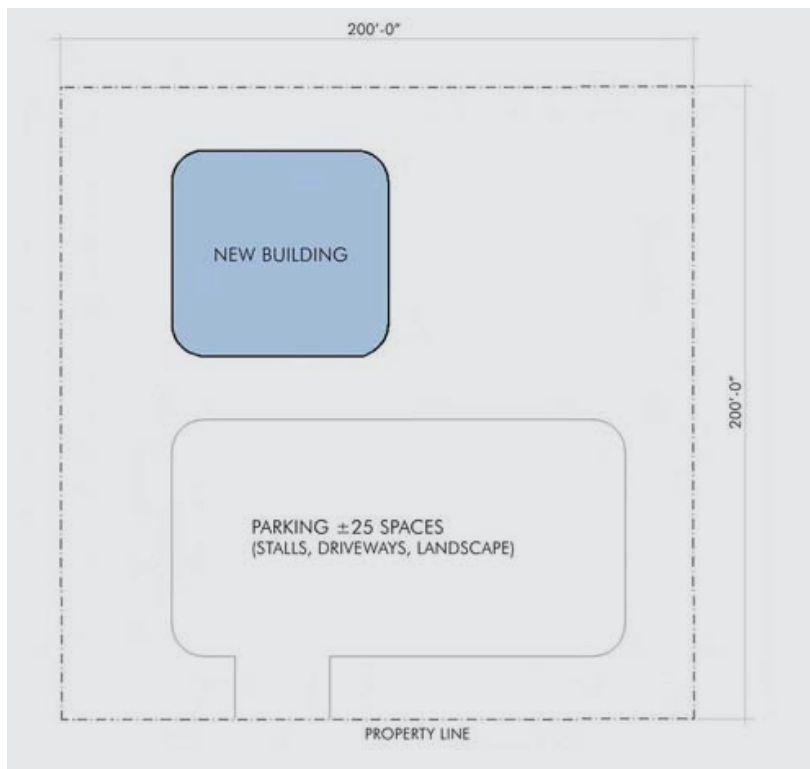
- Build a minimum 4,000 square foot library in Spangle.

Component	Recommended
Collection	16,000
Computers	10
Seating	
Library	40
Meeting room	1 w/50 seats
Conference	1 w/8 seats
Quiet study	0
Building size	4,000 SF

Implementation

The new Spangle Library is in Priority Group 3 and toward the end of Phase 2, with design proposed for 2017 and the new library opening in 2019. Its medium priority is based on physical geography and travel patterns and the unserved Highway 195 corridor.

Prior to development, a site must be acquired and a detailed building program should be prepared as part of a focused pre-design study setting out project requirements, budget, and schedule in detail.



Potential Site Area: approx. .9 acre
■ Potential Building Area: 4,000 SF

Facility Summary:

Moran Prairie and Glenrose Prairie

MORAN PRAIRIE LIBRARY PROFILE

Built: 2006

Expanded: n/a

Remodeled: n/a

Building ownership: Spokane County Library District

Site ownership: Spokane County Library District

Size: 8,400 SF

	2009	5-year % change
Weekly hours open	58	56.8%
Annual visits	124,942	148.2%
Visits per open hour	41	57.7%
Visits per square foot	15	n/a
Annual circulation	169,887	99.8%
Circulation per open hour	56	27.3%
Circulation per square foot	21	n/a
Annual computer bookings	15,730	211.2%

The District's newest branch, Moran Prairie Library, serves Moran and Glenrose Prairie. It's located on an arterial, a couple of blocks south of its intersection with a major thoroughfare and community shopping center. Construction financing was obtained through voter approval to establish the Moran Prairie Library Capital Facility Area (LCFA). The bonds that financed the library's construction will be retired in 2016.

The facility exceeds the 0.5 SF/capita facility space target for its service area and is meeting current customer needs. The building is attractive and well-maintained. The site is the District's most spacious with ample parking and space for outdoor programs.

In addition to use by its service area residents, the library is also heavily used by nearby City of Spokane residents, not included in its population estimate. Materials circulation to those cardholders totals approximately 28% of the library's total.

Library Needs

The Moran Prairie Library facility is currently meeting its service-area resident needs, and based on the 2031 population estimate used in this study, will continue to do so through the end of the planning period.

An annexation mitigation agreement between the District and the City of Spokane provides the option for the city to assume ownership and operation of the Moran Prairie Library when 90% of the UGA's land area has been annexed. Given the property tax base and costs of service for residential areas, it's unlikely this percentage will be reached in the foreseeable future.



Recommendations

- Monitor actual service area population growth throughout the planning period and if the UGA annexation threshold isn't met, and the library continues to be operated by the District, consider the 1,000 square foot addition for which the building was designed.

Component	Existing	Recommended
Collection	37,218	40,000
Computers	12	18
Seating		
Library	61	80
Meeting room	1 w/100 seats	1 w/100 seats
Conference	1 w/8 seats	1 w/8 seats
Quiet study	2 w/2 seats each	2 w/2 seats each
Building size	8,400 SF	9,400 SF

Implementation

The Moran Prairie Library addition and remodel, is in Priority Group 5 at the end of Phase 3. This facility is currently correctly-sized for its service area and if the 2031 population projection is accurate, will continue to meet service area needs until the end of the planning period.



Facility Summary:

Administrative/Support Services

PROFILE

Built: 1990

Expanded: n/a

Remodeled: 1998 (?)

Size: 10,700 SF

Building ownership: Spokane County Library District

Site ownership: Spokane County Library District

Building shared with Argonne Library

The District's Administration/Support Services offices occupy the same building as the Argonne Library, occupying about 10,700 of the building's 20,375 square feet. Approximately 1,800 square feet of that space is an allocation of the common areas shared with the Argonne Library. The IT department is located in the Spokane Valley Library facility.

The building is attractive and well-maintained, with the reception area and adjacent offices and workroom recently updated. Day lighting is very good. Since originally occupied, there was one minor shifting of partition walls and another interior major space reconfiguration to accommodate changing collection services and business office functions.

Administrative/Support Services Needs

Office space for administrative and support services functions is at capacity; it would be difficult to add another staff workstation anywhere in the finished portion of the building. Heating and cooling isn't consistent throughout the building. There is inadequate document storage and the staff restrooms are very small. The IT department outgrew its dedicated space several years ago and is now using part of the Spokane Valley Library's basement for staff and storage. IT would better be co-located with other administrative and support functions. While it might be feasible to abandon the Administrative Offices areas currently used primarily for storage and remodel it for IT use, that would eliminate any ability to provide additional office space for other staff.

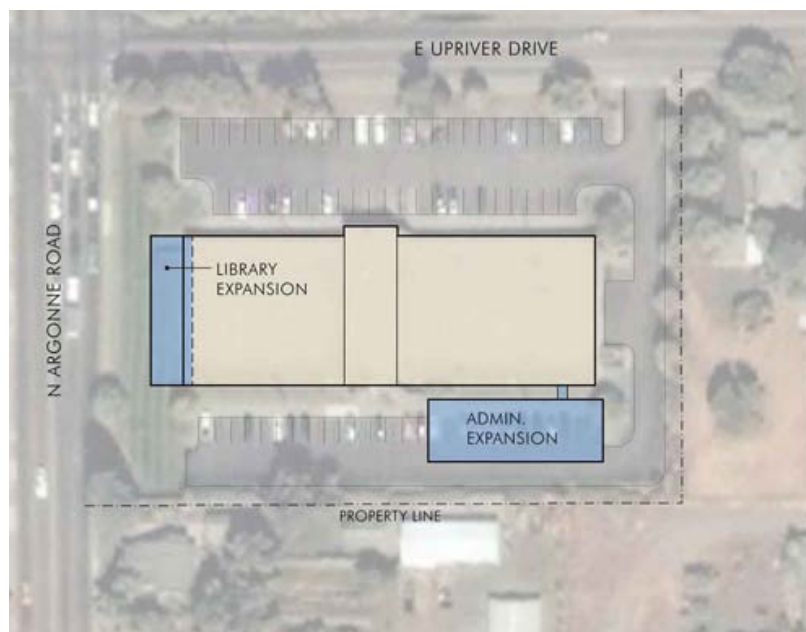
The Argonne building's site is fully occupied by the facility, parking, and required landscaping, except for a small expansion zone at its west end, intended for a small library addition. Without acquiring adjacent residential property, there's no other room for expanding the building footprint. In a 2007 study, Integrus Architecture concluded the most feasible and esthetic approach to additional office space would be to build above the south parking area. Adding a second floor to a portion of the building was deemed to be less practical and potentially more expensive due to the need for structural alterations to support the added floor.

With the addition, about three-quarters of the existing space would need remodeling to accommodate the IT department and the staffing reconfiguration required by the addition.



Recommendations

- Build an Administrative/Support Services Offices 4,300 SF addition above the rear parking lot and remodel most of the existing space to accommodate the IT department, work area and storage needs. Recommended total square footage totals 15,000 SF.



- Existing Building: approx. 18,400 SF
- Potential Expansion- Library: approx. 1875 SF
Admin.: approx. 4300 SF
Remodel- Library: 2000 SF
Admin.: 7000 SF

Implementation

The Administration/Support Services addition and remodel is in Priority Group 1, Phase 1, with design proposed for 2013 and completion in 2016. The high priority of this project is due to the need for IT department space after the existing Spokane Valley Library is vacated and the need for the increased behind-the-scenes operations required to support expanded and additional libraries to follow.

Acknowledgements

The Spokane County Library District Library Facilities Master Plan was prepared with the generous contribution of ideas, advice, and time by many people throughout the District's service area.

COMMUNITY PARTICIPANTS

Customer telephone survey respondents: 401 SCLD cardholders

Community telephone survey respondents: 403 heads of households

Focus group participants: 58 SCLD cardholders

Executive interviews: 26 community leaders

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PROTECTING WATER RESOURCES WITH HIGHER-DENSITY DEVELOPMENT

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To request additional copies of this report, contact EPA's National Service Center for Environmental Publications at 800-490-9198 or by email at ncepimal@one.net and ask for publication number 231-R-06-001.

To access this report online, visit [<www.epa.gov/smartgrowth>](http://www.epa.gov/smartgrowth) or [<www.smartgrowth.org>](http://www.smartgrowth.org).

Front cover photos:

Left: The Snake River flows outside Jackson, Wyoming. Photo courtesy of USDA NRCS.

Top right: Rosslyn-Ballston Corridor, Arlington County, Virginia. Arlington County Department of Community Planning, Housing, and Development received a 2002 National Award for Smart Growth Achievement in the Overall Excellence category for its planning efforts in the Rosslyn-Ballston Corridor. Photo courtesy of Arlington County.

Middle right: People gather at Pioneer Square in Portland, Oregon. Photo courtesy of US EPA.

Back cover photos:

Top left: This hillside in Northern California is covered by wildflowers. This open space provides habitat to wildlife as well as serving important watershed services. Photo courtesy of USDA NRCS.

Middle left: A family enjoys open space in central Iowa. Photo courtesy of USDA NRCS.

Bottom left: A stream flows through western Maryland. Photo courtesy of USDA NRCS.

Right: This redevelopment site in Arlington, Virginia, which includes stores, apartments townhomes, single family homes, parking garages, and a one-acre public park, was formerly a large department store surrounded by surface parking. Photo courtesy of US EPA.



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

WASHINGTON, D.C. 20460

Dear Colleague:

We are excited to share with you the enclosed report, *Protecting Water Resources with Higher-Density Development*. For most of EPA's 35-year history, policymakers have focused on regulatory and technological approaches to reducing pollution. These efforts have met with significant success. But, the environmental challenges of the 21st century require new solutions, and our approach to environmental protection must become more sophisticated. One approach is to partner with communities to provide them with the tools and information necessary to address current environmental challenges. It is our belief that good environmental information is necessary to make sound decisions. This report strives to meet that goal by providing fresh information and perspectives.

Our regions, cities, towns, and neighborhoods are growing. Every day, new buildings or houses are proposed, planned, and built. Local governments, working with planners, citizen groups, and developers, are thinking about where and how this new development can enhance existing neighborhoods and also protect the community's natural environment. They are identifying the characteristics of development that can build vibrant neighborhoods, rich in natural and historic assets, with jobs, housing, and amenities for all types of people. They are directing growth to maintain and improve the buildings and infrastructure in which they have already invested.

In addition to enjoying the many benefits of growth, communities are also grappling with growth's challenges, including development's impact on water resources. In the face of increasing challenges from non-point source pollution, local governments are looking for, and using, policies, tools, and information that enhance existing neighborhoods and protect water resources. This report gives communities a different perspective and set of information to address the complex interactions between development and water quality.

Protecting Water Resources with Higher-Density Development is intended for water quality professionals, communities, local governments, and state and regional planners who are grappling with protecting or enhancing their water resources while accommodating growing populations. We hope that you find this report informative as your community strives to enjoy the many benefits of growth and development and cleaner water.

For additional free copies, please send an e-mail to ncepimal@one.net or call (800) 490-9198 and request EPA publication 231-R-06-001. If you have any questions concerning this study, please do not hesitate to contact Lynn Richards at (202) 566-2858.

Sincerely,

A handwritten signature in black ink, appearing to read "Ben Grumbles".

Ben Grumbles
Assistant Administrator
Office of Water

A handwritten signature in black ink, appearing to read "Brian F. Mannix".

Brian F. Mannix
Associate Administrator
Office of Policy, Economics, and
Innovation

PROTECTING WATER RESOURCES WITH HIGHER-DENSITY DEVELOPMENT

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Executive Summary

Growth and development expand communities' opportunities by bringing in new residents, businesses, and investments. Growth can give a community the resources to revitalize a downtown, refurbish a main street, build new schools, and develop vibrant places to live, work, shop, and play. However, with the benefits come challenges. The environmental impacts of development can make it more difficult for communities to protect their natural resources. Where and how communities accommodate growth has a profound impact on the quality of their streams, rivers, lakes, and beaches. Development that uses land efficiently and protects undisturbed natural lands allows a community to grow and still protect its water resources.

The U.S. Census Bureau projects that the U.S. population will grow by 50 million people, or approximately 18 percent, between 2000 and 2020. Many communities are asking where and how they can accommodate this growth while maintaining and improving their water resources. Some communities have interpreted water-quality research to mean that low-density development will best protect water resources. However, some water-quality experts argue that this strategy can backfire and actually harm water resources. Higher-density development, they believe, may be a better way to protect water resources. This study intends to help guide communities through this debate to better understand the impacts of high- and low-density development on water resources.

To more fully explore this issue, EPA modeled three scenarios of different densities at three scales—one-acre level, lot level, and watershed level—and at three different time series build-out examples to examine the premise that lower-density development is always better for water quality. EPA examined stormwater runoff from different development densities to determine the comparative difference between scenarios. This analysis demonstrated:

- The higher-density scenarios generate less stormwater runoff per house at all scales—one acre, lot, and watershed—and time series build-out examples;
- For the same amount of development, higher-density development produces less runoff and less impervious cover than low-density development; and
- For a given amount of growth, lower-density development impacts more of the watershed.

Taken together, these findings indicate that low-density development may not always be the preferred strategy for protecting water resources. Higher densities may better protect water quality—especially at the lot and watershed levels. To accommodate the same number of houses, denser developments consume less land than lower density developments. Consuming less land means creating less impervious cover in the watershed. EPA believes that increasing development densities is one strategy communities can use to minimize regional water quality impacts. To fully protect water resources, communities need to employ a wide range of land use strategies, based on local factors, including building a range of development densities, incorporating adequate open space, preserving critical ecological and buffer areas, and minimizing land disturbance.

Introduction

Growth and development expand communities' opportunities by bringing in new residents, businesses, and investments. Growth can give a community the resources to revitalize a downtown, refurbish a main street, build new schools, and develop vibrant places to live, work, shop, and play. However, with the benefits come challenges. The environmental impacts of development can make it more difficult for communities to protect their natural resources. Where and how communities accommodate growth has a profound impact on the quality of their streams, rivers, lakes, and beaches. Development that uses land efficiently and protects undisturbed natural lands allows a community to grow and still protect its water resources.

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Virtually every metropolitan area in the United States has expanded substantially in land area in recent decades. According to the U.S. Department of Agriculture's National Resources Inventory (NRI), between 1954 and 1997, urban land area almost quadrupled, from 18.6 million acres to about 74 million acres in the contiguous 48 states (USDA, 1997b). From 1982 to 1997, when population in the contiguous United States grew by about 15 percent, developed land increased by 25 million acres, or 34 percent. Most of this growth is taking place at the edge of developed areas, on greenfield sites, which can include forestland, meadows, pasture, and rangeland (USDA, 1997a). Indeed, in one analysis of building permits in 22 metropolitan areas between 1989 and 1998, approximately 95 percent of building permits were on greenfield sites (Farris, 2001).

According to the American Housing Survey, 35 percent of new housing is built on lots between two and five acres, and the median lot size is just under one-half acre (Census, 2001). Local zoning may encourage building on relatively large lots, in part because local governments often believe that it helps protect their water quality. Indeed, research has revealed that more impervious cover can degrade water quality. Studies have demonstrated that at 10 percent imperviousness, a watershed is likely to become impaired and grows more so as imperviousness increases (Arnold, 1996; Schueler, 1994). This research has prompted many communities to adopt low-density zoning and site-level imperviousness limits, e.g., establishing a percentage of the site, such as 10 or 20 percent, that can be covered by

Which is a better strategy to protect water quality: low- or high-density development?

Between 1954 and 1997, urban land area almost quadrupled, from 18.6 million acres to about 74 million acres in the contiguous 48 states.

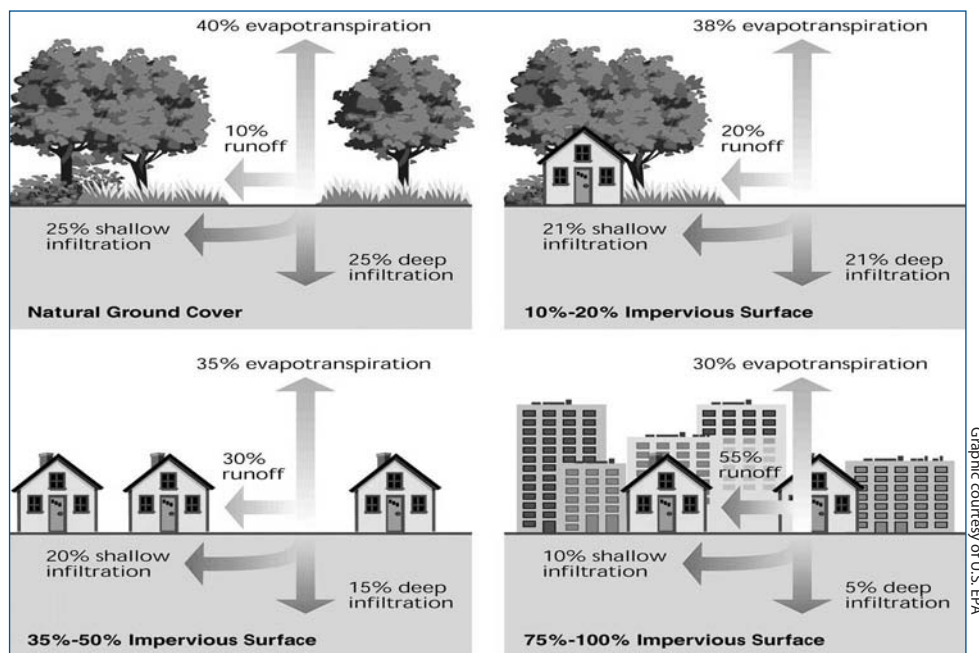
impervious surfaces such as houses, garages, and driveways. These types of zoning and development ordinances are biased against higher-density development because it has more impervious cover. But do low-density approaches protect our water resources?

This study examines the assumption that low-density development is always better for water quality.¹ EPA modeled stormwater runoff from different development densities at the site level and then extrapolated and analyzed these findings at the watershed level. Modeling results were used to compare stormwater runoff associated with several variations of residential density.

Impacts from Development on Watershed Functions

A watershed is a land area that drains to a given body of water. Precipitation that falls in the watershed will either infiltrate into the ground, evapotranspire back into the air, or run off into streams, lakes, or coastal waters. This dynamic is described in Exhibit 1.

EXHIBIT 1: Watershed Services



As land cover changes, so does the amount of precipitation that absorbs into the ground, evaporates into the air, or runs off.

A watershed may be large or small. The Mississippi River, for example, drains a one-million-square-mile watershed made up of thousands of smaller watersheds, such as the drainage basins of the creeks that flow into tributaries of the Mississippi. In smaller watersheds, a few acres of land may drain into small streams, which flow into larger streams or rivers; the lands drained by these streams or rivers make up a larger watershed. These streams support

¹ Stormwater runoff was used as a proxy for overall water quality. In general, the more stormwater runoff a region experiences, the more associated pollutants, such as total nitrogen, phosphorus, and suspended solids, will enter receiving waterbodies.

diverse aquatic communities and perform the vital ecological roles of processing the carbon, sediments, and nutrients upon which downstream ecosystems depend. Healthy, functioning watersheds naturally filter pollutants and moderate water quality by slowing surface runoff and increasing the infiltration of water into soil. The result is less flooding and soil erosion, cleaner water downstream, and greater ground water reserves.

Land development directly affects watershed functions. When development occurs in previously undeveloped areas, the resulting alterations to the land can dramatically change how water is transported and stored. Residential and commercial development create impervious surfaces and compacted soils that filter less water, which increases surface runoff and decreases ground water infiltration. These changes can increase the volume and velocity of runoff, the frequency and severity of flooding, and peak storm flows.

Moreover, during construction, exposed sediments and construction materials can be washed into storm drains or directly into nearby bodies of water. After construction, development usually replaces native meadows, forested areas, and other natural landscape features with compacted lawns, pavement, and rooftops. These largely impervious surfaces generate substantial runoff. For these reasons, limiting or minimizing the amount of land disturbed and impervious cover created during development can help protect water quality.

Critical Land Use Components for Protecting Water Quality for Both Low- and High-Density Development

What strategies can communities use to continue to grow while protecting their water quality? Watershed hydrology suggests that three primary land use strategies can help to ensure adequate water resource protection:

- Preserve large, continuous areas of absorbent open space;
- Preserve critical ecological areas, such as wetlands, floodplains, and riparian corridors; and
- Minimize overall land disturbance and impervious surface associated with development.

These approaches work because, from a watershed perspective, different land areas have different levels of ecological value. For example, a nutrient-rich floodplain has a higher ecological value than a grass meadow. Communities should view these strategies as basic steps to preserve watershed function and as the framework within which all development occurs.

PRESERVING OPEN SPACE

Preserving open space is critical to maintaining water quality at the regional level. Large, continuous areas of open space reduce and slow runoff, absorb sediments, serve as flood control, and help maintain aquatic communities. To ensure well-functioning watersheds, regions should set aside sufficient amounts of undisturbed, open space to absorb, filter, and store rainwater. In most regions, this undeveloped land comprises large portions of a watershed, filtering

out trash, debris, and chemical pollutants before they enter a community's water system. Open space provides other benefits, including habitat for plants and animals, recreational opportunities, forest and ranch land, places of natural beauty, and community recreation areas.

To protect these benefits, some communities are preserving undeveloped parcels or regional swaths of open space. One of the most dramatic examples is the New York City Watershed Agreement. New York City, New York State, over 70 towns, eight counties, and EPA signed the agreement to support an enhanced watershed protection program for the New York City drinking water supply. The city-funded, multi-year, \$1.4-billion agreement developed a multi-faceted land conservation approach, which includes the purchase of 80,000 acres within the watershed as a buffer around the city's drinking water supply. This plan allows the city to avoid the construction of filtration facilities estimated to cost six to eight billion dollars (New York City, 2002).

PRESERVING ECOLOGICALLY SENSITIVE AREAS

Some types of land perform watershed functions better than others do. Preserving ecologically important land, such as wetlands, buffer zones, riparian corridors, and floodplains, is critical for regional water quality. Wetlands are natural filtration plants, slowing water flow and allowing sediments to settle and the water to clarify. Trace metals bound to clay carried in runoff also drop out and become sequestered in the soils and peat at the bed of the marsh instead of entering waterbodies, such as streams, lakes, or rivers. Preserving and maintaining wetlands are critical to maintain water quality.



Photo courtesy of USDA NRCS

Wetlands, such as this one in Butte County, California, provide critical watershed services for the region.

runoff, giving the sediment time to settle and water time to percolate, filter through the soil, and recharge underlying ground water. Research has shown that wetlands and buffer zones, by slowing and holding water, increase ground water recharge, which directly reduces the potential for flooding (Schueler, 1994). By identifying and preserving these critical ecological areas, communities are actively protecting and enhancing their water quality.

In addition, strips of vegetation along streams and around reservoirs are important buffers, with wooded buffers offering the greatest protection. For example, if soil conditions are right, a 20- to 30-foot-wide strip of woodland removes 90 percent of the nitrates in stormwater runoff (Trust for Public Land, 1997). These buffer zones decrease the amount of pollution entering the water system. Tree and shrub roots hold the bank in place, preventing erosion and its resulting sedimentation and turbidity. Organic matter and grasses slow the flow of

MINIMIZING LAND DISTURBANCE AND IMPERVIOUS COVER

Minimizing land disturbance and impervious cover is critical to maintaining watershed health. The amount of land that is converted, or “disturbed,” from undeveloped uses, such as forests and meadows, to developed uses, such as lawns and playing fields, significantly affects watershed health. Research now shows that the volume of runoff from highly compacted lawns is almost as high as from paved surfaces (Schueler, 1995, 2000; USDA, 2001). This research indicates that lawns and other residential landscape features do not function, with regard to water, in the same way as nondegraded natural areas. In part, the difference arises because developing land in greenfield areas involves wholesale grading of the site and removal of topsoil, which can lead to severe erosion during construction, and soil compaction by heavy equipment. However, most communities focus not on total land disturbed, but on the amount of impervious cover created.

Research has revealed a strong relationship between impervious cover and water quality (Arnold, 1996; Schueler, 1994; EPA, 1997). Impervious surfaces collect and accumulate pollutants deposited from the atmosphere, leaked from vehicles, or derived from other sources. During storms, accumulated pollutants are quickly washed off and rapidly delivered to aquatic systems. Studies have demonstrated that at 10 percent imperviousness,² a watershed is likely to become impaired (Schueler, 1996; Caraco, 1998; Montgomery County, 2000), the

stream channel becomes unstable due to increased water volumes and stream bank erosion, and water quality and stream biodiversity decrease. At 25 percent imperviousness, a watershed becomes severely impaired, the stream channel can become highly unstable, and water quality and stream biodiversity are poor³ (Schueler, 2000). The amount of impervious cover is an important indicator of watershed health, and managing the degree to which a watershed is developed is critical to maintaining watershed function.

Although the 10 percent threshold refers to overall imperviousness within the watershed, municipalities have applied it to individual sites within the watershed, believing that lower densities better protect watershed functions. Indeed, as mentioned earlier, some localities have gone so far as to create strong incentives for, or even require, low densities—with water resource protection as an explicit goal. These communities are attempting to minimize hard



Photo courtesy of USDA NRCS

Current construction practices generally disturb the entire development site, as shown by this site in Des Moines, Iowa.

² The 10 percent figure is not an absolute threshold. Recent studies have indicated that in some watersheds, serious degradation may begin well below 10 percent. However, the level at which watershed degradation begins is not the focus of this study. For purposes of our analysis, EPA uses the 10 percent threshold as an indicator that water resources might be impacted.

³ There are different levels of impairment. In general, when the term is used in EPA publications, it usually means that a waterbody is not meeting its designated water quality standard. However, the term can also imply a decline or absence of biological integrity; for example, the waterbody can no longer sustain critical indicator species, such as trout or salmon. Further, there is a wide breadth of levels of impairment, from waterbodies that are unable to support endangered species to waterbodies that cannot support any of the beneficial-use designations.

surfaces at the site level. They believe that limiting densities within particular development sites limits regional imperviousness and thus protects regional water quality. The next section examines this proposition and finds that low-density development can, in fact, harm water quality.

Low-Density Development—Critiquing Conventional Wisdom

As discussed, studies have demonstrated that watersheds can suffer impairment at 10 percent impervious cover and that at 25 percent imperviousness, the watershed is typically considered severely impaired. Communities have often translated these findings into the notion that low-density development at the site level results in better water quality. Such conclusions often come from analysis such as: a one-acre site has one or two homes with a driveway and a road passing by the property. The remainder of the site is lawn. Assuming an average housing footprint of 2,265 square feet⁴ (National Association of Home Builders, 2001), the impervious cover for this one-acre site is approximately 35 percent (Soil Conservation Service, 1986). By contrast, a higher-density scenario might have eight to 10 homes per acre and upwards of 85 percent impervious cover (Soil Conservation Service, 1986). The houses' footprints account for most of the impervious cover. Thus, low-density zoning appears to create less impervious cover, which ought to protect water quality at the site and regional levels. However, this logic overlooks several key caveats.

1. *The “pervious” surface left in low-density development often acts like impervious surface.* In general, impervious surfaces, such as a structure's footprint, driveways, and roads, have higher amounts of runoff and associated pollutants than pervious surfaces. However, most lawns, though pervious, still contribute to runoff because they are compacted. Lawns are thought to provide “open space” for infiltration of water. However, because of construction practices, the soil becomes compacted by heavy equipment and filling of depressions (Schueler, 1995, 2000). The effects of this compaction can remain for years and even increase due to mowing and the presence of a dense mat of roots. Therefore, a one- or two-acre lawn does not offer the same infiltration or other water quality functions as a one- or two-acre undisturbed forest. Minimizing impervious surfaces by limiting the number of houses but allowing larger lawns does not compensate for the loss of watershed services that the area provided before development (USDA, 2001).
Lawns still contribute to runoff because they are compacted and disturbed.
2. *Density and imperviousness are not equivalent.* Depending on the design, two houses may actually create as much imperviousness as four houses. The impervious area per home can vary widely due to road infrastructure, housing design (single story or multistory), or length and width of driveways. To illustrate, a three-story condominium building of 10 units on one acre can have less impervious surface than four single-family homes on the same acre. Furthermore, treatment of the remaining undeveloped land on that acre can

⁴ The average house built in 2001 included three or more bedrooms, two and a half baths, and a two-car garage.

vary dramatically between housing types. For example, in some dispersed, low-density communities, such as Fairfax County, Virginia, some homeowners are paving their front lawns to create more parking for their cars (Rein, 2002).

3. *Low-density developments often mean more off-site impervious infrastructure.* Development in the watershed is not simply the sum of the sites within it. Rather, total impervious area in a watershed is the sum of site developments plus the impervious surface associated with infrastructure supporting those sites, such as roads and parking lots. Lower-density development can require substantially higher amounts of this infrastructure per house and per acre than denser developments. Recent research has demonstrated that on sites with two homes per acre, impervious surfaces attributed to streets, driveways, and parking lots can represent upwards of 75 percent of the total site imperviousness (Cappiella, 2001). That number decreases to 56 percent on sites with eight homes per acre. This research indicates that low densities often require more off-site transportation-related impervious infrastructure, which is generally not included when calculating impervious cover.

Water quality suffers not only from the increase in impervious surface, but also from the associated activities: construction, increased travel to and from the development, and extension of infrastructure.

Furthermore, water quality suffers not only from the increase in impervious surface, but also from the associated activities: construction, increased travel to and from the development, extension of infrastructure, and chemical maintenance of the areas in and surrounding the development. Oil and other waste products, such as heavy metals, from motor vehicles, lawn fertilizers, and other common solvents, combined with the increased flow of runoff, contribute substantially to water pollution. As imperviousness increases, so do associated activities, thereby increasing the impact on water quality.

4. *If growth is coming to the region, limiting density on a given site does not eliminate that growth.* Density limits constrain the amount of development on a site but have little effect on the region's total growth (Pendall, 1999, 2000). The rest of the growth that was going to come to the region still comes, regardless of density limits in a particular place. Forecasting future population growth is a standard task for metropolitan planning organizations as they plan where and how to accommodate growth in their region. They project future population growth based on standard regional population modeling practices, where wage or amenity differentials, such as climate or culture (Mills, 1994)—and not zoning practices such as density limits—account for most of a metropolitan area's population gain or loss.⁵ While estimates of future growth within a particular time frame are rarely precise, a region must use a fixed amount of growth to test the effects of adopting

Growth is still coming to a region, regardless of density limits in a particular place.

⁵ The most widely-used such model—the REMI® Policy Insight™ model—uses an amenity variable. However, even this is implemented as an additional change in the wage rate. See Remi Model Structure. <www.remi.com/Overview/Evaluation/Structure/structure.html>. The in-house model used by the San Diego Association of Governments is an advanced example of the type used by councils of governments around the country. <www.sandag.cog.ca.us/resources/demographics_and_other_data/demographics/forecasts/index.asp>.

different growth planning strategies because it still must understand the economic, social, and environmental impacts of accommodating a growing population. Absent regional coordination and planning, covering a large part of a region with density limits will likely drive growth to other parts of the region. Depending on local conditions, water quality may be more severely impaired than if the growth had been accommodated at higher densities on fewer sites.

Testing the Alternative: Can Compact Development Minimize Regional Water Quality Impacts?

To more fully understand the potential water quality impacts of different density levels, this section compares three hypothetical communities, each accommodating development at different densities—one house per acre, four houses per acre, and eight houses per acre.⁶ To assess regional water quality impacts, EPA modeled the stormwater impacts from different development densities. In general, the more stormwater runoff generated within a region, the more associated pollutants, such as total nitrogen, phosphorus, and suspended solids, will enter receiving waterbodies. The three density levels capture some of the wide range of zoning practices in use throughout the country. All of these densities are consistent with single-family, detached housing. EPA examined the stormwater impacts from each density scenario at various scales of residential development⁷—one-acre, lot, and watershed levels—and through a 40-year time series build-out analysis.

The Model and Data Inputs

The model used to compare the stormwater impact from the scenarios is the Smart Growth Water Assessment Tool for Estimating Runoff (SG WATER), which is a peer-reviewed sketch model that was developed specifically to compare water quantity and quality differences among different development patterns (EPA, 2002). SG WATER's methodology is based on the Natural Resources Conservation Service (NRCS) curve numbers (Soil Conservation Service, 1986), event mean concentrations, and daily rainfall data.⁸ The model requires the total number of acres developed at a certain development density. If density is unknown, total percent imperviousness can be used. The model was run using overall percent imperviousness.

EPA believes that the results presented here are conservative. SG WATER uses a general and simple methodology based on curve numbers. One limitation of curve numbers is that they tend to underestimate stormwater runoff for smaller storms (less than one inch). This underestimate

⁶ Densities at one, four, and eight residential units per acre are used here for illustrative purposes only. Many communities now are zoning for one unit per two acres at the low-density end of the spectrum. Low-density residential zoning exists in places as diverse as Franklin County, Ohio, which requires no less than two acres per unit (<www.co.franklin.oh.us/development/franklin_co/LDR.html#304.041>) to Cobb County, Georgia, outside of Atlanta, which requires between one and two units per acre in its low-density residential districts (<www.cobb-county.org/community/plan_bza_commission.htm>). By comparison, some communities are beginning to allow higher densities, upwards of 20 units per acre. For example, the high-density residential district in Sonoma County, California permits between 12 and 20 units per acre (<www.sonoma-county.org/prmd/Zoning/article_24.htm>), and the city of Raleigh, North Carolina, allows up to 40 units per acre in planned development districts.

⁷ This example and others throughout this study compare residential units, but a similar comparison including commercial development could also be done.

⁸ Daily time-step rainfall data for a 10-year period (1992–2001, inclusive) were used.

can be significant since the majority of storms are small storms. In addition, the curve numbers tend to overestimate runoff for large storms. However, curve numbers more accurately predict runoff in areas with more impervious cover.⁹ For the analysis here, the runoff from the low-density site is underestimated to a larger degree than the runoff from the higher-density site because the higher-density site has more impervious cover. Simply put, because of methodology, the difference in the numbers presented here is conservative—it is likely that the comparative difference in runoff between the sites would be greater if more extensive modeling were used.

To isolate the impacts that developing at different densities makes on stormwater runoff, EPA made several simplifying assumptions in the modeling:

- EPA modeled only residential growth and not any of the corresponding commercial, retail, or industrial growth that would occur in addition to home building. Moreover, EPA assumed that all the new growth would occur in greenfields (previously undeveloped land). Infill development, brownfield redevelopment, and other types of urban development were not taken into consideration, nor were multifamily housing, apartments, or accessory dwelling units.¹⁰
- The modeling did not take into account any secondary or tertiary impacts, such as additional stormwater benefits, that may be realized by appropriately locating the development within the watershed. For example, siting development away from headwaters, recharge areas, or riparian corridors could better protect these sensitive areas. Denser development makes this type of protective siting easier since less land is developed. However, these impacts are not captured or calculated within the modeling.
- Whether developed at one, four, or eight houses per acre, when one acre is developed, EPA assumed the entire acre is disturbed land (e.g., no forest or meadow cover would be preserved), which is consistent with current construction practices.
- All the new growth is assumed to be single-family, detached houses.¹¹ Whether developed at one, four, or eight houses per acre, each home has a footprint of 2,265 square feet, roughly the current average size for new houses (National Association of Home Builders, 2001).

⁹ Most existing stormwater models incorrectly predict flows associated with small rains in urban areas. Most existing urban runoff models originated from drainage and flooding evaluation procedures that emphasized very large rains (several inches in depth). These large storms contribute only very small portions of the annual average discharges. Moderate storms, occurring several times a year, are responsible for the majority of the pollutant discharges. These frequent discharges cause mostly chronic effects, such as contaminated sediment and frequent high flow rates, and the inter-event periods are not long enough to allow the receiving water conditions to recover.

¹⁰ Single-family, detached housing dominates many low-density residential developments. However, higher-density developments support a range of housing types, including townhouses, apartments, and other forms of multifamily housing. These housing types generally have a smaller footprint per house than 2,265 square feet. Therefore, a more realistic situation for the higher-density scenarios would either be a smaller housing footprint or an increase in the number of homes accommodated on one acre. In either case, including these different housing types in the analysis would produce less overall stormwater runoff and less per house runoff for the higher-density scenarios.

¹¹ It is possible that when additional land uses, such as commercial, transportation, or recreation, are included in the analysis, the low-density scenarios become relatively less dense while the higher-density scenarios become relatively more dense. In general, low-density residential development tends to be associated with low-density commercial development, characterized by large retail spaces, wide roads, large parking lots, and minimal public transportation. Higher-density residential areas are more likely to have high-density commercial options, with smaller retail spaces, mixed land uses, narrower streets, parking garages, on-street parking, and sometimes a well-developed public transportation system, which can reduce parking needs.

- The same percentage of transportation-associated infrastructure, such as roads, parking lots, driveways, and sidewalks, is allocated to each community acre, based on the curve number methodology from the NRCS. For example, each scenario has the same width of road, but because the higher-density scenario is more compact, it requires fewer miles of roads than the lower-density scenarios. So while the same percentage is applied, the amounts differ by scenario. Collector roads or arterials that serve the development are not included.
- The modeled stormwater runoff quantity for each scenario is assumed to come from one hypothetical outfall.
- The model does not take into account wastewater or drinking water infrastructure, slope, or other hydrological interactions that the more complex water modeling tools use.

Summary of Scenarios

Example 1 examines the stormwater runoff impacts on a one-acre lot that accommodates one house (Scenario A), four houses (Scenario B), or eight houses (Scenario C). Example 2 expands the analysis to examine stormwater runoff impacts within a lot-level development that accommodates the same number of houses. Because of different development densities, this growth requires different amounts of land. Scenario A requires eight acres for eight houses, Scenario B requires two acres for eight houses, and Scenario C requires one acre for eight houses.

Examples 3, 4, and 5 explore the relationship between density and land consumption by building in a watershed at different densities. Again, different amounts of land are required to support the same amount of housing. Examples 6, 7, and 8 examine how the hypothetical community grows over a 40-year timeframe with different development densities.

The scenarios and scales of development are summarized in Exhibit 2. EPA expects to capture the differences in stormwater runoff associated with different development densities by using these three scenarios (Scenarios A, B, and C) at four different scales (one acre, lot, watershed, and build-out).

EXHIBIT 2: Summary of Scenarios

Scale of Analysis	Scenario A: One house per acre	Scenario B: Four houses per acre	Scenario C: Eight houses per acre
Example 1: One acre	1 house per acre	4 houses per acre	8 houses per acre
Example 2: Lot—Each development lot accommodates the same number of houses	8 houses built on 8 acres	8 houses built on 2 acres	8 houses built on 1 acre

Example 3: Watershed— Each 10,000-acre watershed accommodates the same number of houses	10,000 houses built on 10,000 acres	10,000 houses built on 2,500 acres or $\frac{1}{4}$ of the watershed	10,000 houses built on 1,250 acres or $\frac{1}{8}$ of the watershed
Example 4: Watershed— Each 10,000-acre watershed is fully built out at different densities	10,000 houses built on 10,000 acres	40,000 houses built on 10,000 acres	80,000 houses built on 10,000 acres
Example 5: Watershed— Each scenario accommodates the same number of houses	80,000 houses consume 8 watersheds	80,000 houses consume 2 watersheds	80,000 houses consume 1 watershed
Example 6: Hypothetical build-out in the year 2000	10,000 houses built on 10,000 acres	10,000 houses built on 2,500 acres	10,000 houses built on 1,250 acres
Example 7: Hypothetical build-out in the year 2020	20,000 houses built on 20,000 acres, or 2 watersheds	20,000 houses built on 5,000 acres, or $\frac{1}{2}$ of 1 watershed	20,000 houses built on 2,500 acres, or $\frac{1}{4}$ of 1 watershed
Example 8: Hypothetical build-out in the year 2040	40,000 houses built on 40,000 acres, or 4 watersheds	40,000 houses built on 10,000 acres, or 1 watershed	40,000 houses built on 5,000 acres, or $\frac{1}{2}$ of 1 watershed

Before analyzing the impacts of these different scenarios, it is useful to clarify some underlying premises. This analysis assumes that:

1. Metropolitan regions will continue to grow. This assumption is consistent with U.S. Census Bureau projections that the U.S. population will grow by roughly 50 million people by 2020 (Census, 2000). Given this projected population growth, most communities across the country are or will be determining where and how to accommodate expected population increases in their regions.
2. Housing density affects the distribution of new growth within a given region, not the amount of growth. Individual states and regions grow at different rates depending on a variety of factors, including macroeconomic trends (e.g., the technology boom in the 1980s spurring development in the Silicon Valley region in California) and demographic shifts. Distribution and density of new development do not significantly affect these factors.

- The model focuses on the comparative differences in stormwater runoff between scenarios, not absolute values. As discussed, using the curve number and event mean concentration approach can underestimate the total quantity of stormwater runoff for smaller storm events and in areas of lower densities. Because of this and other model simplifications discussed above, the analysis does not focus on the absolute value of stormwater runoff generated for each scenario but instead focuses on the comparative difference, or the delta, in runoff between scenarios.

Results


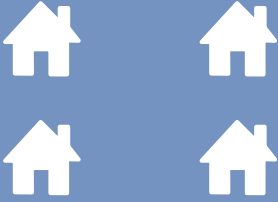

The results from the eight examples for all three scenarios are presented below.

EXAMPLE 1: ONE-ACRE LEVEL

Scale of Analysis	Scenario A	Scenario B	Scenario C
One Acre	1 house	4 houses	8 houses

EPA examined one acre developed at three different densities: one house, four houses, and eight houses. The results are presented in Exhibit 3. As Exhibit 3 demonstrates, the overall percent imperviousness for Scenario A is approximately 20 percent with one house per acre, 38 percent for Scenario B with four houses per acre, and 65 percent for Scenario C with eight houses per acre (Soil Conservation Service, 1986).

EXHIBIT 3: Total Average Annual Stormwater Runoff for All Scenarios

Scenario A	Scenario B	Scenario C
		
Impervious cover = 20% Runoff/acre = 18,700 ft ³ /yr Runoff/unit = 18,700 ft ³ /yr	Impervious cover = 38% Runoff/acre = 24,800 ft ³ /yr Runoff/unit = 6,200 ft ³ /yr	Impervious cover = 65% Runoff/acre = 39,600 ft ³ /yr Runoff/unit = 4,950 ft ³ /yr

Examining the estimated average annual runoff at the acre level, as illustrated in Exhibit 4, the low-density Scenario A, with just one house, produces an average runoff volume of 18,700 cubic feet per year (ft³/yr). Scenario C, with eight houses, produces 39,600 ft³/yr, and Scenario B falls between Scenarios A and C at 24,800 ft³/yr. In short, looking at the comparative differences between scenarios, runoff roughly doubles as the number of houses increases from one house per acre to eight houses per acre. Scenario C, with more houses on the acre, has the greatest amount of impervious surface cover and thus generates the most runoff at the acre level.

Looking at the comparative difference of how much runoff each individual house produces, in Scenario A, one house yields 18,700 ft³/yr, the same as the per acre level. In the denser Scenario C, however, each house produces 4,950 ft³/yr average runoff. The middle scenario, Scenario B, produces considerably less runoff—6,200 ft³/yr—per house than Scenario A, but more than Scenario C. Each house in Scenario B produces approximately 67 percent less runoff than a house in Scenario A, and each house in Scenario C produces 74 percent less runoff than a house in Scenario A. This is because the houses in Scenarios B and C create less impervious surface per house than the house in Scenario A. Therefore, per house, each home in the higher-density communities results in less stormwater runoff.

Each house in Scenario B produces approximately 67 percent less runoff than a house in Scenario A, and each house in Scenario C produces 74 percent less runoff than a house in Scenario A.









Modeling at the acre level demonstrates that, in this example, when density is quadrupled (from one house to four houses), stormwater runoff increases by one-third per acre, but decreases by two-thirds per house. Moreover, when density increases by a factor of eight—from one house to eight houses—stormwater runoff doubles per acre, but decreases by almost three-quarters per house.









These results indicate when runoff is measured by the acre, limiting density does minimize water quality impacts compared to the higher-density scenarios. However, when measured by the house, higher densities produce less stormwater runoff.









EXAMPLE 2: LOT LEVEL

Scale of Analysis	Scenario A	Scenario B	Scenario C
Lot	8 houses built on 8 acres	8 houses built on 2 acres	8 houses built on 1 acre

EXHIBIT 4: Each Scenario Accommodates Eight Houses

Scenario A		
		
		
Impervious cover = 20%	Total runoff (18,700 ft ³ /yr x 8 acres) = 149,600 ft ³ /yr	Runoff/house = 18,700 ft ³ /yr

Scenario B	   	   
Impervious cover = 38%	Total runoff (24,800 ft ³ /yr x 2 acres) = 49,600 ft ³ /yr	Runoff/house = 6,200 ft ³ /yr

Scenario C	       	
Impervious cover = 65%	Total runoff = 39,600 ft ³ /yr	Runoff/house = 4,950 ft ³ /yr

For each development to accommodate the same number of houses, the lower-density scenarios require more land to accommodate the same number of houses that Scenario C has accommodated on one acre. Specifically, Scenario A must develop seven additional acres, or eight acres total, to accommodate the same number of houses as Scenario C. Scenario B must develop two acres to accommodate the same number of houses. Exhibit 4 illustrates.

The increase in runoff for Scenario A is due to the additional land consumption.

With each scenario accommodating the same number of houses, this analysis shows that total average runoff in Scenario A is 149,600 ft³/yr (18,700 ft³/yr x 8 acres), which is a 278 percent increase from the 39,600 ft³/yr total runoff in Scenario C. Total average runoff from eight houses in Scenario B is 49,600 ft³/yr (24,800 ft³/yr x 2 acres), which is a 25 percent increase in runoff from Scenario C. The increase in runoff for Scenario A is due to the additional land consumption and associated runoff. The impervious cover for Scenario A remains the same at 20 percent, but now, seven additional acres have 20 percent impervious cover.

Examining the comparative difference in runoff between scenarios shows that lower densities can create less total impervious cover, but produce more runoff when the number of houses is kept consistent between scenarios. Furthermore, the higher-density scenario produces less runoff per house and per lot.

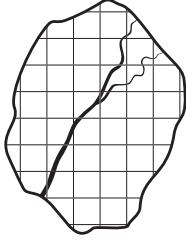
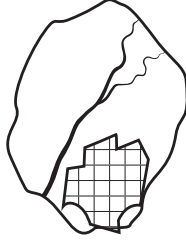
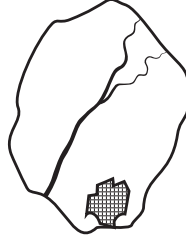
EXAMPLE 3: WATERSHED LEVEL

Scale of Analysis	Scenario A	Scenario B	Scenario C
Watershed—Each 10,000-acre watershed accommodates the same number of houses	10,000 houses built on 10,000 acres	10,000 houses built on 2,500 acres	10,000 houses built on 1,250 acres

Taking the analysis to the watershed level, EPA examined the comparative watershed stormwater runoff impacts from accommodating growth at different densities. The watershed used in this analysis is a hypothetical 10,000-acre watershed accommodating only houses. As discussed, the modeling does not include retail, business centers, farms, or any other land uses typically seen in communities, nor does it take into consideration where the development occurs within the watershed. Research has shown that upper sub-watersheds, which contain smaller streams, are generally more sensitive to development than lower sub-watersheds (Center for Watershed Protection, 2001).

Accommodating 10,000 houses at one house per acre in the 10,000-acre watershed would fully build out the watershed. At the higher density of four houses per acre, one-quarter of the watershed would be developed, and at eight houses per acre, one-eighth of the watershed would be developed. Exhibit 5 shows the runoff associated with each of these scenarios.

EXHIBIT 5: 10,000-Acre Watershed Accommodating 10,000 Houses

Scenario A	Scenario B	Scenario C
		
<p>10,000 houses built on 10,000 acres produce: 10,000 acres x 1 house x 18,700 ft³/yr of runoff =</p> <p>187 million ft³/yr of stormwater runoff</p> <p>Site: 20% impervious cover</p> <p>Watershed: 20% impervious cover</p>	<p>10,000 houses built on 2,500 acres produce: 2,500 acres x 4 houses x 6,200 ft³/yr of runoff =</p> <p>62 million ft³/yr of stormwater runoff</p> <p>Site: 38% impervious cover</p> <p>Watershed: 9.5% impervious cover</p>	<p>10,000 houses built on 1,250 acres produce: 1,250 acres x 8 houses x 4,950 ft³/yr of runoff =</p> <p>49.5 million ft³/yr of stormwater runoff</p> <p>Site: 65% impervious cover</p> <p>Watershed: 8.1% impervious cover</p>

As Exhibit 5 illustrates, if development occurs at a lower density, e.g., one house per acre, the entire watershed will be built out, generating 187 million ft³/yr of stormwater runoff. Scenario B, at four houses per acre, consumes less land and produces approximately 62 million ft³/yr of stormwater runoff, while Scenario C, at the highest density, consumes the least amount of land and produces just 49.5 million ft³/yr of stormwater runoff. Looking at the comparative differences, Scenario A generates approximately three times as much runoff from development as Scenario B, and approximately four times as much stormwater runoff as Scenario C.

Exhibit 5 also illustrates that, in this example, overall impervious cover for the watershed decreases as site density increases. Scenario C, which has a lot-level imperviousness of 65 percent, has a watershed-level imperviousness of only 8.1 percent, which is lower than the 10

Overall impervious cover for the watershed decreases as site density increases.

percent threshold discussed earlier. Scenario B, with a density of four houses per acre, has a site-level impervious cover of 38 percent, but a watershed imperviousness of 9.5 percent, which is still lower than the 10 percent threshold. Finally, Scenario A, at a lot-level imperviousness of 20 percent, has the same overall imperviousness at the watershed level. **Both of the higher-density scenarios consume less land and maintain below-the-threshold imperviousness.**

This simplistic illustration demonstrates a basic point of this analysis—higher-density developments can minimize stormwater impacts because they consume less land than their lower-density counterparts. For example, imagine if Manhattan, which accommodates 1.54 million people on 14,720 acres (23 square miles) (Census, 2000), were developed not at its current density of 52 houses per acre, but at one or four houses per acre. At one house per acre, Manhattan would need approximately 750,000 more acres, or an additional 1,170 square miles, to accommodate its current population at two people per household.

At one house per acre, Manhattan would need approximately 750,000 more acres, or an additional 1,170 square miles, to accommodate its current population at two people per household.

That’s approximately the size of Rhode Island. At four houses per acre, Manhattan would need approximately 175,000 more acres, or an additional 273 square miles.

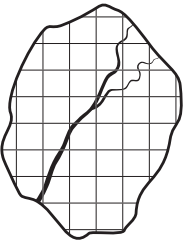
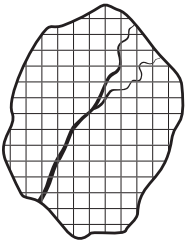
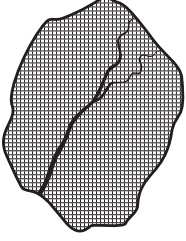
Reducing land consumption is crucial to preserving water quality because, as discussed previously, preserving large, continuous areas of open space and sensitive ecological areas is critical for maintaining watershed services. In addition, because of their dense development pattern, Scenarios B and C may realize additional stormwater benefits if the developed land is appropriately sited in the watershed to protect sensitive ecological areas, such as headwaters, wetlands, riparian corridors, and floodplains.

EXAMPLE 4: REMAINING LAND IN THE WATERSHED DEVELOPED

What happens if the remaining undeveloped parts of the watershed in Scenarios B and C are developed? Exhibit 6 considers this situation.

Scale of Analysis	Scenario A	Scenario B	Scenario C
Watershed—Each 10,000-acre watershed is fully built out at different densities	10,000 houses built on 10,000 acres	40,000 houses built on 10,000 acres	80,000 houses built on 10,000 acres

EXHIBIT 6: 10,000-Acre Watershed Accommodating Different Numbers of Houses

Scenario A	Scenario B	Scenario C
		
<p>The watershed is fully built out at <i>1 house per acre</i>. 10,000 acres accommodates 10,000 houses, translating to:</p> <p>10,000 acres x 1 house x 18,700 ft³/yr of runoff =</p> <p>187 million ft³/yr stormwater runoff</p> <p>Site: 20% impervious cover</p> <p>Watershed: 20% impervious cover</p>	<p>The watershed is fully built out at <i>4 houses per acre</i>. 10,000 acres accommodates 40,000 houses, translating to:</p> <p>10,000 acres x 4 houses x 6,200 ft³/yr of runoff =</p> <p>248 million ft³/yr stormwater runoff</p> <p>Site: 38% impervious cover</p> <p>Watershed: 38% impervious cover</p>	<p>The watershed is fully built out at <i>8 houses per acre</i>. 10,000 acres accommodates 80,000 houses, translating to:</p> <p>10,000 acres x 8 houses x 4,950 ft³/yr of runoff =</p> <p>396 million ft³/yr stormwater runoff</p> <p>Site: 65% impervious cover</p> <p>Watershed: 65% impervious cover</p>

Each watershed is fully built out, and the watershed developed at the highest density (Scenario C) is generating approximately double the total stormwater runoff of Scenario A. Scenario B is generating approximately one-third more runoff than Scenario A. Similar to the acre-level and lot-level results, Scenario C has the highest degree of impervious cover at 65 percent, while Scenario A maintains the lowest level at 20 percent.

Scenarios A and B accommodate only a small portion of the expected growth. The rest will have to be built in other watersheds.

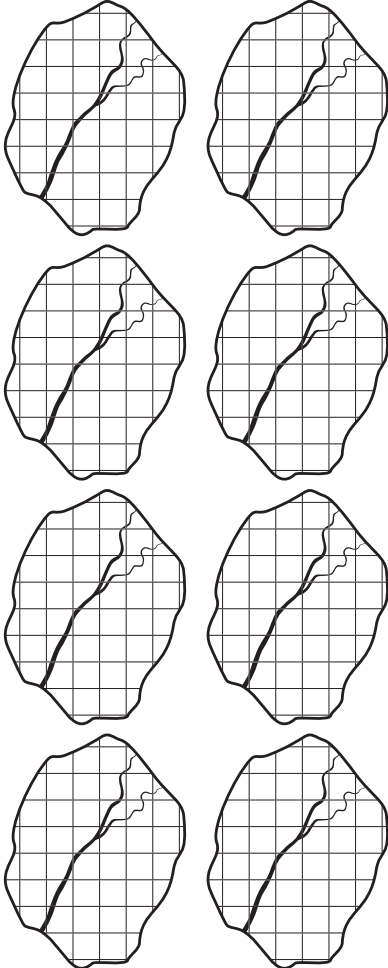
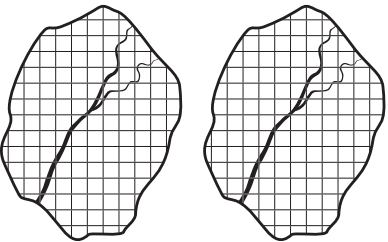
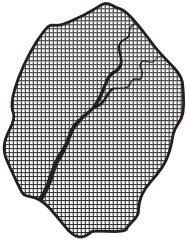
The higher densities found in Scenario B and C are degrading their watershed services to a greater extent than Scenario A. However, the number of houses accommodated in each community is not the same. Scenario B is accommodating **30,000 more houses** (four times the number of Scenario A), and Scenario C is accommodating **70,000 more houses** (eight times the number of Scenario A). Recall that density limits shift growth and do not generally affect the total amount of growth in a given time period. Therefore, this is not a fair comparison. Scenarios A and B accommodate only one-eighth and one-half, respectively, of the 80,000 houses accommodated in Scenario C. Where do the other houses, households, and families go? To get a true appreciation for the effects of density, Scenarios A and B must also show where those homes will be accommodated. It is likely that they would be built in nearby or adjacent watersheds. Our hypothetical community that develops at one house per acre (Scenario A) is able to accommodate only 10,000 houses. For the community that develops at that density to accommodate the same number of houses that Scenario C contains, it must disturb and develop land from nearby or adjacent watersheds.

EXAMPLE 5: ACCOMMODATING THE SAME NUMBER OF HOUSES

Scale of Analysis	Scenario A	Scenario B	Scenario C
Watershed—Each scenario accommodates the same number of houses	1 house per acre—80,000 houses consume 8 watersheds	4 houses per acre—80,000 houses consume 2 watersheds	8 houses per acre—80,000 houses consume 1 watershed

As discussed, the U.S. population will increase by an estimated 50 million people by 2020. Different areas of the country will grow at different rates in the future. Whether a region anticipates 1,000 or 80,000 new households to come to the region over the next 10 years, comparisons between build-out scenarios must keep the number of homes consistent. In this case, if Scenario C is developed so that its entire watershed is built out to 80,000 houses, then for a fair comparison, Scenarios A and B must also include 80,000 houses. Exhibit 7 illustrates this situation.

EXHIBIT 7: 80,000 Houses Accommodated

Scenario A	Scenario B	Scenario C
		
<p>At 1 house per acre, 80,000 houses require 80,000 acres, or 8 <i>watersheds</i>, translating to:</p> <p>80,000 acres x 1 house x 18,700 ft³/yr of runoff =</p> <p>1.496 billion ft³/yr of stormwater runoff</p> <p>8 watersheds at 20% impervious cover</p>	<p>At 4 houses per acre, 80,000 houses require 20,000 acres, or 2 <i>watersheds</i>, translating to:</p> <p>20,000 acres x 4 houses x 6,200 ft³/yr of runoff =</p> <p>496 million ft³/yr of stormwater runoff</p> <p>2 watersheds at 38% impervious cover</p>	<p>At 8 houses per acre, 80,000 houses require 10,000 acres, or 1 <i>watershed</i>, translating to:</p> <p>10,000 acres x 8 houses x 4,950 ft³/yr of runoff =</p> <p>396 million ft³/yr of stormwater runoff</p> <p>1 watershed at 65% impervious cover</p>

When the number of houses is kept consistent, Scenario A would need to develop an *additional seven watersheds* (assuming the same size watersheds) and Scenario B would need to develop *one additional watershed* to accommodate the same growth found in Scenario C.

As Exhibit 7 demonstrates, for Scenario A to accommodate the additional 70,000 homes already accommodated in Scenario C, it must develop another seven watersheds. This generates 1.496 billion ft³/yr of stormwater runoff. Scenario C, with a development density of eight houses per acre, has still developed just one watershed and is generating approximately 74 percent less stormwater runoff than Scenario A—or 396 million ft³/yr. Scenario B, at four houses per acre, is generating 496 million ft³/yr runoff, or two-thirds less runoff than Scenario A, but 100 million ft³/yr more than Scenario C.

Scenario A would need to develop an *additional seven watersheds* and Scenario B would need to develop *one additional watershed* in order to accommodate the same growth found in Scenario C.

EXAMPLE 6: TIME SERIES BUILD-OUT ANALYSIS: BUILD-OUT IN 2000

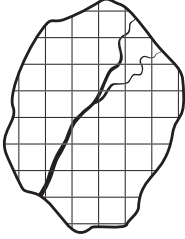
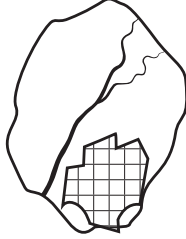
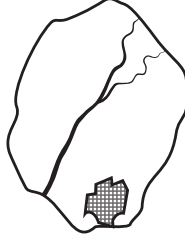
Scale of Analysis	Scenario A	Scenario B	Scenario C
Hypothetical build-out in the year 2000	10,000 houses built on 10,000 acres	10,000 houses built on 2,500 acres	10,000 houses built on 1,250 acres

Another way to examine this issue is to look at what happens to build-out of the three scenarios over time. A basic assumption for EPA’s modeling is that growth is coming to the hypothetical community, and that growth will be accommodated within a fixed time horizon. But what happens to growth in the hypothetical community over several, sequential time horizons?

Given the dynamic nature of population growth, what will build-out look like in the hypothetical community in 2000, 2020, and 2040 at different development densities? The next several examples examine the amount of land required to accommodate increasing populations within a watershed that develops at different densities. The purpose of this time series build-out is to examine how much land is consumed as the population grows in 20-year increments.

Starting in the year 2000, the three watersheds each begin with 10,000 homes. The only difference between the watersheds is the densities at which the building occurs. In 2000, they might look something like Exhibit 8.

EXHIBIT 8: Time Series Build-out Analysis: Build-out in 2000

Scenario A	Scenario B	Scenario C
		
10,000 houses on 10,000 acres at a density of 1 house per acre consume 1 entire watershed.	10,000 houses on 2,500 acres at a density of 4 houses per acre consume ¼ of 1 watershed.	10,000 houses on 1,250 acres at a density of 8 houses per acre consume ⅛ of 1 watershed.

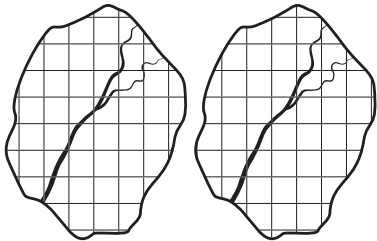
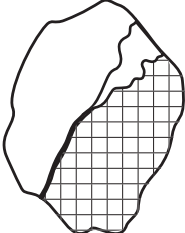
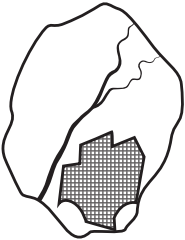
As previously demonstrated in Example 3, building at higher densities consumes, or converts, less land within the watershed. Scenario A, developing at one unit per acre, requires the entire 10,000-acre watershed to accommodate 10,000 houses. Scenario C, on the other hand, developing at eight units an acre, requires significantly less land to accommodate the same amount of development.

EXAMPLE 7: TIME SERIES BUILD-OUT ANALYSIS: BUILD-OUT IN 2020

Scale of Analysis	Scenario A	Scenario B	Scenario C
Hypothetical build-out in the year 2020	20,000 houses built on 20,000 acres, or 2 watersheds	20,000 houses built on 5,000 acres, or ½ of 1 watershed	20,000 houses built on 2,500 acres, or ¼ of 1 watershed

Fast-forwarding 20 years, the population in the hypothetical community has doubled from 10,000 houses to 20,000 houses. Each scenario must accommodate this additional growth at different development densities. Exhibit 9 demonstrates how this development might look.

EXHIBIT 9: Time Series Build-out Analysis: Build-out in 2020

Scenario A	Scenario B	Scenario C
		
20,000 houses accommodated on 20,000 acres at a density of 1 house per acre will consume 2 watersheds.	20,000 houses accommodated on 5,000 acres at a density of 4 houses per acre will consume ½ of 1 watershed.	20,000 houses accommodated on 2,500 acres at a density of eight houses per acre will consume ¼ of 1 watershed.

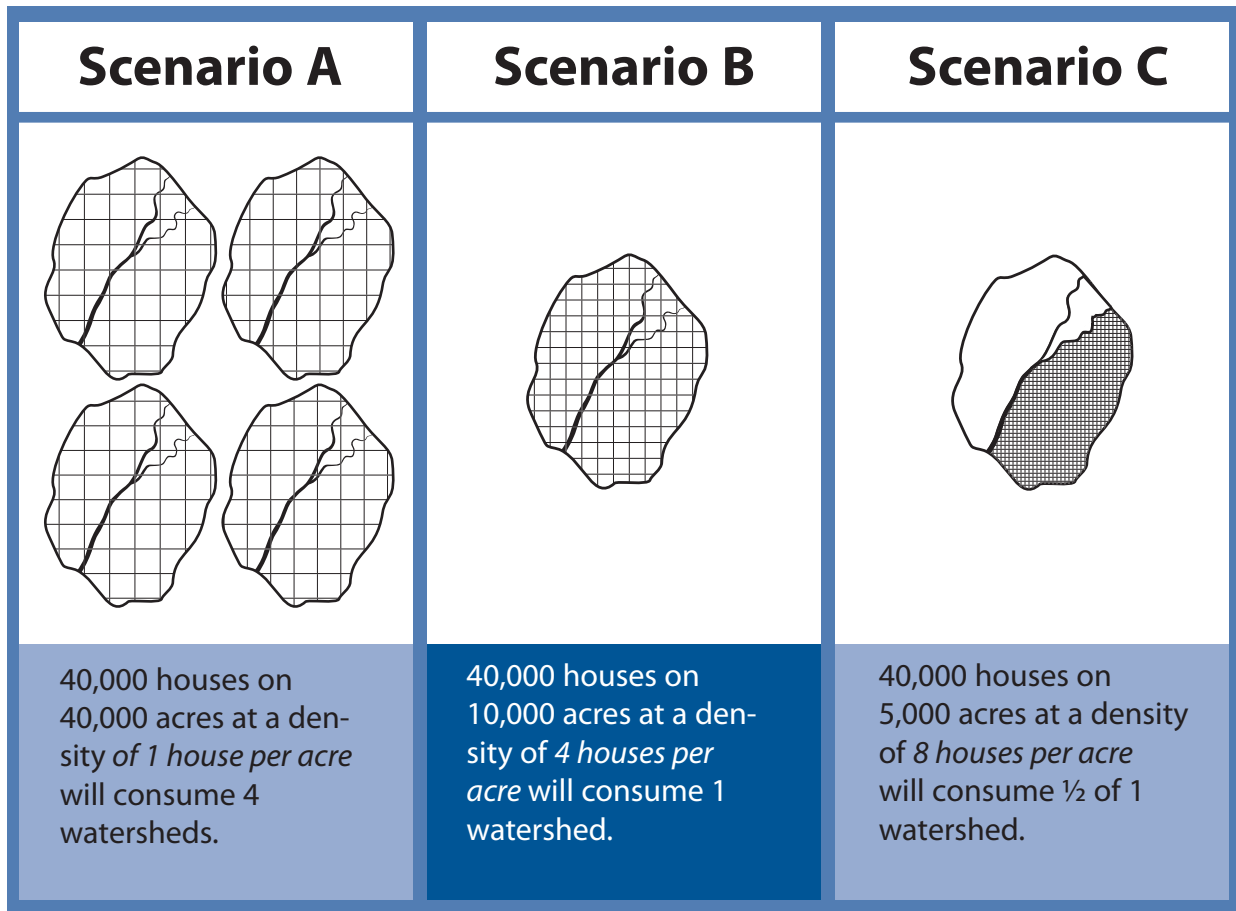
As Exhibit 9 demonstrates, Scenario A, developing at one house per acre, requires another whole watershed to accommodate the additional growth. Scenarios B and C, developing at higher densities, can accommodate the additional growth within the same watershed. Moreover, by developing at higher densities within the watershed, ample open space or otherwise undeveloped land remains to perform critical watershed functions. No such land exists in Scenario A, and, as previously discussed, lawns typically associated with one house per acre are not able to provide the same type of watershed services as forests, meadows, or other types of unconverted land.

EXAMPLE 8: TIME SERIES BUILD-OUT ANALYSIS: BUILD-OUT IN 2040

Scale of Analysis	Scenario A	Scenario B	Scenario C
Hypothetical build-out in the year 2040	40,000 houses built on 40,000 acres, or 4 watersheds	40,000 houses built on 10,000 acres, or 1 watershed	40,000 houses built on 5,000 acres, or ½ of 1 watershed

The hypothetical community continues to grow and, in another 20 years, population has doubled again, requiring each scenario to accommodate 20,000 more homes at different development densities. Exhibit 10 demonstrates how this development might look.

EXHIBIT 10: Time Series Build-out Analysis: Build-out in 2040



As Exhibit 10 demonstrates, Scenario A, developing at one house per acre, must develop land in four watersheds, or 40,000 acres, to accommodate all its houses. Scenario B, developing at a slightly higher density, uses its remaining land to accommodate the additional growth. Scenario C is still developing within the same watershed and still has additional land available to provide watershed services. Scenario A and B do not. Any land for watershed services would need to come from additional watersheds.

Lower-density development always requires more land than higher densities to accommodate the same amount of growth.

This build-out analysis can continue indefinitely with the same result: lower-density development always requires more land than higher densities to accommodate the same amount of growth. Because more land is required, more undeveloped land is converted.

Findings/Discussion

The results indicate when runoff is measured *by the acre*, limiting density does produce less stormwater runoff when compared to the higher-density scenarios. However, when measured *by the house*, higher densities produce less stormwater runoff. So, which is the appropriate measure?

Typically, a planning department analyzes the projected stormwater runoff impacts of a developer's proposal based on the acreage, not the number of houses being built. Based on the results from the one-acre level example, communities might conclude that lower-density development would minimize runoff. Runoff from one house on one acre is roughly half the runoff from eight houses. However, where did the other houses, and the people who live in those houses, go? The answer is almost always that they went somewhere else in that region—very often somewhere within the same watershed. Thus, those households still have a stormwater impact. To better understand the stormwater runoff impacts from developing at low densities, the impacts associated with those houses locating elsewhere need to be taken into account. This approach has two advantages:

- It acknowledges that the choice is not whether to grow by one house or eight but is instead where and how to accommodate the eight houses (or whatever number by which the region is expected to grow).
- It emphasizes minimization of total imperviousness and runoff within a region or watershed rather than from particular sites—which is more consistent with the science indicating that imperviousness within the watershed is critical.

To more fully explore this dynamic, EPA modeled scenarios at three scales—one acre, lot, and watershed—and at three different time series build-out examples to examine the premise that lower-density development better protects water quality. EPA examined stormwater runoff from different development densities to determine the comparative difference between scenarios. The higher-density scenarios generated less stormwater runoff per house at all scales and time series build-out examples. Exhibit 11 summarizes these findings.

EXHIBIT 11: Summary of Findings

Scenario	Number of Acres Developed	Impervious Cover (%)	Total Runoff (ft³/yr)	Runoff Per Unit (ft³/yr)	Savings Over Scenario A: runoff per unit (%)
One-Acre Level: Different densities developed on one acre					
A: One house/acre	1	20.0	18,700	18,700	0
B: Four houses/acre	1	38.0	24,800	6,200	67
C: Eight houses/acre	1	65.0	39,600	4,950	74
Lot Level: Eight houses accommodated at different density levels					
Scenario A	8	20.0	149,600	18,700	0
Scenario B	2	38.0	49,600	6,200	67
Scenario C	1	65.0	39,600	4,950	74
Watershed Level: 10,000 houses accommodated in one 10,000-acre watershed					
Scenario A	10,000	20.0	187 M	18,700	0
Scenario B	2,500	9.5	62 M	6,200	67
Scenario C	1,250	8.1	49.5 M	4,950	74
Scenario	Summary of Build-out Examples				
Watershed Level: Time Series Build-out Analysis: Build-out in 2000					
Scenario A	10,000 houses built on 10,000 acres: 1 watershed is consumed				
Scenario B	10,000 houses built on 2,500 acres: ¼ of 1 watershed is consumed				
Scenario C	10,000 houses built on 1,250 acres: ⅛ of 1 watershed is consumed				
Watershed Level: Time Series Build-out Analysis: Build-out in 2020					
Scenario A	20,000 houses built on 20,000 acres: 2 watersheds are consumed				
Scenario B	20,000 houses built on 5,000 acres: ½ of 1 watershed is consumed				
Scenario C	20,000 houses built on 2,500 acres: ¼ of 1 watershed is consumed				
Watershed Level: Time Series Build-out Analysis: Build-out in 2040					
Scenario A	40,000 houses built on 40,000 acres: 4 watersheds are consumed				
Scenario B	40,000 houses built on 10,000 acres: 1 watershed is consumed				
Scenario C	40,000 houses built on 5,000 acres: ½ of 1 watershed is consumed				

Specifically, this analysis demonstrates:

- With more dense development (Scenario C), runoff rates per house decrease by approximately 74 percent from the least dense scenario (Scenario A);
- For the same amount of development, denser development produces less runoff and less impervious cover than low-density development; and
- For a given amount of growth, lower-density development uses more of the watershed.

EPA found that the higher-density scenarios generate less stormwater runoff per house at all scales—one acre, lot, watershed—and time series build-out examples.

Taken together, these findings indicate that low-density development may not always be the preferred strategy for reducing stormwater runoff. In addition, the findings indicate that higher densities may better protect water quality—especially at the lot and watershed levels. Higher-density developments consume less land to accommodate the same number of houses as lower density. Consuming less land means less impervious cover is created within the watershed. To better protect watershed function, communities must preserve large, continuous areas of open space and protect sensitive ecological areas, regardless of how densely they develop.

However, while increasing densities on a regional scale can, on the whole, better protect water resources at a regional level, higher-density development can have more site-level impervious cover, which can exacerbate water quality problems in nearby or adjacent waterbodies. To address this increased impervious cover, numerous site-level techniques are available to mitigate development impacts. When used in combination with regional techniques, these site-level techniques can prevent, treat, and store runoff and associated pollutants. Many of these practices incorporate some elements of low-impact development techniques (e.g., rain gardens, bioretention areas, and grass swales), although others go further to include changing site-design practices, such as reducing parking spaces, narrowing streets, and eliminating cul-de-sacs.

Incorporating these techniques can help communities meet their water quality goals and create more interesting and enjoyable neighborhoods.

A University of Oregon study, *Measuring Stormwater Impacts of Different Neighborhood Development Patterns* (University of Oregon, 2001), supports this conclusion. The study, which included a study site near Corvallis, Oregon, compared stormwater management strategies in three common neighborhood development patterns. For example, best management practices, such as disconnecting



Photo courtesy of the City of Portland, Oregon

The city of Portland, Oregon, is developing urban stormwater strategies, such as these curb extensions that can absorb the street's runoff from large storm events.

residential roofs and paved areas from the stormwater system, introducing swales and water detention ponds into the storm sewer system, and strategically locating open space, considerably reduced peak water runoff and improved infiltration. The study concluded that “some of the most effective opportunities for reducing stormwater runoff and decreasing peak flow are at the site scale and depend on strategic integration with other site planning and design decisions.” The study also found that planting strips and narrower streets significantly reduced the amount of pavement and, as a result, runoff in developed areas.

A development in Tacoma, Washington, demonstrates that increasing densities and addressing stormwater at the site level can work effectively. The Salishan Housing District was built on Tacoma’s eastern edge in the 1940s as temporary housing for ship workers. It is currently a public housing community with 855 units.

Redevelopment of Salishan will increase densities to include 1,200 homes (public housing, affordable and market rate rentals, and for-sale units), local retail, a farmers market, a senior housing facility, a daycare center, a health clinic, commercial office space, and an expanded community center. Among the most important priorities for the redevelopment is restoring the water quality of Swan Creek, which forms the eastern edge of Salishan. The creek is a spawning ground for indigenous salmon populations that feed into the Puyallup River and Puget Sound. The site plan seeks to restore 65 percent of the land to forest and pervious landscape. In addition, the streets will be narrowed to reduce impervious surfaces and also make the neighborhood more inviting for walking. Some streets may be eliminated and replaced with pedestrian paths. The remaining streets will be bordered by rain gardens that would accept, filter, and evapotranspire runoff. Most existing street surfaces would be reused, although some may be replaced with pervious pavers.

Salishan Housing District is replacing 855 public housing units with 1,200 units. Numerous site-level strategies, such as integrating uses, narrowing the streets, installing rain gardens, and daylighting a stream, are used to restore the water quality of Swan Creek and revitalize an existing neighborhood.

Communities can enjoy a further reduction in runoff if they take advantage of underused properties, such as infill, brownfield, or greyfield¹² sites. For example, an abandoned shopping center (a greyfield property) is often almost completely impervious cover and is already producing high volumes of runoff (Sobel, 2002). If this property were redeveloped, the net runoff increase would likely be zero since the property was already predominately impervious cover. In many cases, redevelopment of these properties breaks up or removes some portion of the impervious cover, converting it to pervious cover and allowing for some stormwater infiltration. In this case, redevelopment of these properties can produce a net improvement in regional water quality by decreasing total runoff. Exhibit 12 illustrates this opportunity.

¹² Greyfield sites generally refer to abandoned or underutilized shopping malls, strip malls, or other areas that have significant paved surface and little or no contamination.

EXHIBIT 12: Redevelopment of a Greyfield Property



Redevelopment of a former shopping mall in Boca Raton, Florida, provides an example of this type of opportunity. The Mizner Park shopping mall was redesigned from its original pattern of a large retail structure surrounded by surface parking lots; the 29-acre site now includes 272 apartments and townhouses, 103,000 square feet of office space, and 156,000 square feet of retail space. Most parking is accommodated in four multistory parking garages. Designed as a village within a city, the project has a density five times higher than the rest of the city and a mix of large and small retailers, restaurants, and entertainment venues (Cooper, 2003). Most significantly, the final build-out of Mizner Park decreased overall impervious surface on the site by 15 percent through the addition of a central park plaza, flower and tree planters, and a large public amphitheater.

Redeveloping brownfield and greyfield sites can reduce regional land consumption. A recent George Washington University study found that for every brownfield acre that is redeveloped, 4.5 acres of open space are preserved (Deason, 2001). In addition to redeveloping brownfield sites, regions can identify underused properties or land, such as infill or greyfield sites, and target those areas for redevelopment. For example, a recent analysis by King County, Washington, demonstrated that property that is vacant and eligible for redevelopment in the county's growth areas can accommodate 263,000 new houses—enough for



The redevelopment of Mizner Park, a former shopping mall, decreased impervious cover by 15 percent through the addition of this central plaza.

500,000 people (Pryne, 2002). Redeveloping this property is an opportunity to accommodate new growth without expanding into other watersheds. As Kurt Zwikl, executive director of the Pottstown, Pennsylvania-based Schuylkill River Greenway Association, said, “Certainly, if we can get redevelopment going in brownfields and old industrial sites in older riverfront boroughs like Pottstown and Norristown, that’s a greenfield further out in the watershed that has been preserved to absorb more stormwater” (Brandt, 2004).

Redeveloping brownfield and greyfield sites can reduce regional land consumption.

Other Research

Current research supports the findings of this study. Several site-specific studies have been conducted across the United States and in Australia that examine stormwater runoff and associated pollutants in relation to different development patterns and densities. Several case studies approach the research question with varying levels of complexity. Studies of Highland Park, Australia; Belle Hall, South Carolina; New Jersey; Chicago, Illinois; and the Chesapeake Bay each analyze the differences in runoff and associated water pollution from different types of development patterns.

Queensland University of Technology, Gold Coast City Council, and the Department of Public Works in Brisbane, Australia, examined the relationship between water quality and six different land uses to offer practical guidance in planning future developments. When comparing monitored runoff and associated pollutants from six areas, they found the most protective strategy for water quality was high-density residential development (Goonetilleke, 2005).

The Belle Hall study, by the South Carolina Coastal Conservation League, examined the water quality impacts of two development alternatives for a 583-acre site in Mount Pleasant, South Carolina. The town planners used modeling to examine the potential water quality impacts of each site design. In the “Sprawl Scenario,” the property was analyzed as if it developed along a conventional suburban pattern. The “Town Scenario” incorporated traditional neighborhood patterns. In each scenario, the overall density and intensity (the number of homes and the square feet of commercial and retail space) were held constant. The results found that the “Sprawl Scenario” consumed eight times more open space and generated 43 percent more runoff, four times more sediment, almost four times more nitrogen, and three times more phosphorous than the “Town Scenario” development (South Carolina Coastal Conservation League, 1995).

These findings hold at a larger, state scale. New Jersey’s State Plan calls for increasing densities in the state by directing development to existing communities and existing infrastructure. Researchers at Rutgers University analyzed the water quality impacts from current development trends and compared them to water quality impacts from the proposed compact development. The study found that compact development would generate significantly less water pollution than current development patterns, which are mostly characterized by low-density development, for all categories of pollutants (Rutgers University, 2000). The reductions ranged from over 40 percent for phosphorus and nitrogen to 30 percent for runoff. These conclusions supported a similar statewide study completed in 1992 that

concluded that compact development would result in 30 percent less runoff and 40 percent less water pollution than would a lower-density scenario (Burchell, 1995).

Researchers at Purdue University examined two possible project sites in the Chicago area (Harbor, 2000). The first site was in the city; the second was on the urban fringe. The study found that placing a hypothetical low-density development on the urban fringe would produce 10 times more runoff than a higher-density development in the urban core.

Finally, a study published by the Chesapeake Bay Foundation in 1996 comparing conventional and clustered suburban development on a rural Virginia tract found that clustering would convert 75 percent less land, create 42 percent less impervious surface, and produce 41 percent less stormwater runoff (Pollard, 2001). These studies suggest that a low-density approach to development is not always the preferred strategy for protecting water resources.

Conclusions

Our regions, cities, towns, and neighborhoods are growing. Every day, new buildings or houses are proposed, planned, and built. Local governments, working with planners, citizen groups, and developers, are thinking about where and how this new development can enhance existing neighborhoods and also protect the community's natural environment. They are identifying the characteristics of development that can build vibrant neighborhoods, rich in natural and historic assets, with jobs, housing, and amenities for all types of people. They are directing growth to areas that will maintain and improve the buildings and infrastructure in which they have already invested. In addition to enjoying the many benefits of growth, communities are also grappling with growth's challenges, including development's impact on water resources.

Many communities assume that low-density development automatically protects water resources. This study has shown that this assumption is flawed and that pursuit of low-density development can in fact be counterproductive, contributing to high rates of land conversion and stormwater runoff and missing opportunities to preserve valuable land within watersheds.

The purpose of this study is to explore the effects of development density on stormwater runoff and to illustrate the problems with the assumption that low-density development is automatically a better strategy to protect water quality. To that end, three different development densities were modeled at the one-acre, lot, and watershed levels, as well as in the time series build-out examples. The modeling results suggest that low-density development is not always the preferred strategy for protecting water resources. Furthermore, the results seem to suggest that higher-density development could better protect regional water quality because it consumes less land to accommodate the same number of homes.

However, while this study shows that low-density development does not automatically better protect water resources, it does not conclude that high-density development is therefore necessarily more protective. This study has not considered all factors, such as location of development within the watershed, varying soil types, slope, advanced post-construction controls (and their performance over time), and many other factors. In that sense, this study concludes that there

are good reasons to consider higher-density development as a strategy that can better protect water resources than lower-density development. However, any bias toward either is inappropriate from a water perspective. A superior approach to protect water resources locally is likely to be some combination of development densities, based on local factors, incorporating adequate open space, preserving critical ecological and buffer areas, and minimizing land disturbance.

These conclusions have implications for how communities can enjoy the benefits of growth and development while also protecting their water quality. Additional relevant information can be found in other resources, such as *Protecting Water Resources with Smart Growth* and *Using Smart Growth Techniques as Stormwater Best Management Practices*.¹³ Both publications draw on the experience of local governments, which has shown that regional and site-specific strategies are most effective when implemented together. In addition, *Creating Great Neighborhoods: Density in Your Community*, by the Local Government Commission and the National Association of Realtors, can provide information on some of the other benefits from density that communities can enjoy.

Nationwide, state and local governments are considering the environmental implications of development patterns. As low-density development and its attendant infrastructure consume previously undeveloped land and create stretches of impervious cover throughout a region, the environment is increasingly affected. In turn, these land alterations are not only likely to degrade the quality of the individual watershed, but are also likely to degrade a larger number of watersheds. EPA believes that increasing development densities is one strategy communities can use to minimize regional water quality impacts.

Additional relevant information can be found in these resources:

- *Protecting Water Resources with Smart Growth*, available at: www.epa.gov/smart-growth/pdf/waterresources_with_sg.pdf.
- *Creating Great Neighborhoods: Density in Your Community*, available at: www.epa.gov/smart-growth/pdf/density.pdf.

¹³ Forthcoming EPA publication.

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EPA 231-R-06-001
January 2006
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BEFORE THE BOARD OF COUNTY COMMISSIONERS OF SPOKANE COUNTY, WASHINGTON

IN THE MATTER OF THE ADOPTION
OF THE 2012-2017 SIX-YEAR
TRANSPORTATION IMPROVEMENT PROGRAM
INCLUDING THE SIX-YEAR URBAN AREA
CONSTRUCTION PROGRAM, THE SIX-YEAR
RURAL AREA CONSTRUCTION PROGRAM,
THE 2012 ANNUAL CONSTRUCTION PROGRAM AND
THE 2012 COUNTY ARTERIAL PRESERVATION PROGRAM
AND THE 2012 EQUIPMENT PURCHASE LIST

RESOLUTION

WHEREAS, the Spokane County Engineer has submitted for consideration the attached 2012-2017 SIX-YEAR TRANSPORTATION IMPROVEMENT PROGRAM, including the SIX-YEAR URBAN AREA CONSTRUCTION PROGRAM, the SIX-YEAR RURAL AREA CONSTRUCTION PROGRAM, the 2012 ANNUAL CONSTRUCTION PROGRAM, the 2012 COUNTY ARTERIAL PRESERVATION PROGRAM and the 2012 EQUIPMENT PURCHASE LIST; and

WHEREAS, a priority array of county road arterials was available and used as a guide to the preparation of the six-year program; and

WHEREAS, a bridge inspection report was prepared and used as a guide to the preparation of the six-year program; and

WHEREAS, an environmental assessment has been made of the projects listed in the programs; and

WHEREAS, the programs are consistent with the Adopted Comprehensive Plan; and

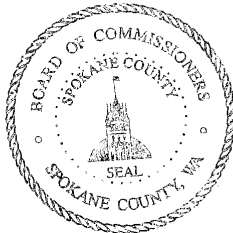
WHEREAS, the Board of County Commissioners has reviewed the 2012-2017 SIX-YEAR TRANSPORTATION IMPROVEMENT PROGRAM, including the SIX-YEAR URBAN AREA CONSTRUCTION PROGRAM, the SIX-YEAR RURAL AREA CONSTRUCTION PROGRAM, the 2012 ANNUAL CONSTRUCTION PROGRAM, the 2012 COUNTY ARTERIAL PRESERVATION PROGRAM and the 2012 EQUIPMENT PURCHASE LIST and has found them to be logical proposals which meet the requirements of the existing Washington state law.

THEREFORE, BE IT RESOLVED by the Board of County Commissioners of Spokane County, Washington, that the attached 2012-2017 SIX-YEAR TRANSPORTATION IMPROVEMENT PROGRAM, including the SIX-YEAR URBAN AREA CONSTRUCTION PROGRAM, the SIX-YEAR RURAL AREA CONSTRUCTION PROGRAM, the 2012 ANNUAL CONSTRUCTION PROGRAM, the 2012 COUNTY ARTERIAL PRESERVATION PROGRAM and the 2012 EQUIPMENT PURCHASE LIST are unanimously approved.

BE IT FURTHER RESOLVED, that the County Engineer be and is authorized to proceed with preliminary engineering and right of way acquisition for the projects outlined in the 2012-2017 SIX-YEAR TRANSPORTATION IMPROVEMENT PROGRAM, including the SIX-YEAR URBAN AREA CONSTRUCTION PROGRAM, the SIX-YEAR RURAL AREA CONSTRUCTION PROGRAM, the 2012 ANNUAL CONSTRUCTION PROGRAM, the 2012 COUNTY ARTERIAL PRESERVATION PROGRAM and the 2012 EQUIPMENT PURCHASE LIST.

BE IT FURTHER RESOLVED, that the projects included in the programs are found to be environmentally insignificant, with the exception of those projects indicated otherwise.

ADOPTED by the Board of County Commissioners of Spokane County, Washington, this *8th* day of *Nov.*, 2011.



ATTEST:

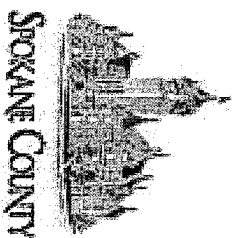
Daniela Erickson
Daniela Erickson
Clerk of the Board

Al French
Al French, Chair

Todd Mielke
Todd Mielke, Vice-Chair

Mark Richard
Mark Richard, Commissioner

11-0988



Spokane County
Department of Public Works
Engineering Division
2012 - 2017 Six Year Transportation Improvement Program
2012 Annual Construction Program

**SPOKANE COUNTY
DEPARTMENT OF PUBLIC WORKS
ENGINEERING DIVISION
2012-2017 SIX YEAR TRANSPORTATION IMPROVEMENT PROGRAM
2012 ROAD ANNUAL CONSTRUCTION PROGRAM, SUPPLEMENTAL SECTION
2012-2017 SIX YEAR URBAN ARTERIAL CONSTRUCTION PROGRAM (UCPUAP), SUPPLEMENTAL SECTION
2012-2012 SIX YEAR RURAL ARTERIAL CONSTRUCTION PROGRAM (RAP)
2012 COUNTY ARTERIAL PRESERVATION PROGRAM (CAPP)**

Presented to the Board are two programs - a short-range and a long-range road construction program for Spokane County. The short-range program is the Annual Construction Program for 2012. This program consists of projects with approved funding from both grants and the County Road Fund.

The long-range, or Six-Year Transportation Improvement Program for the years 2012 through 2017, includes about 95 million dollars of proposed construction. The program is intended to guide the planning and implementation of road construction work. The projects indicated for the late years of the program are more general and subject to revision as conditions and funding change.

Over the program period, construction funds are anticipated to decrease in spite of an anticipated growth in property values. This is due to steadily increasing maintenance costs, both labor and materials, and because future gas tax revenue is not anticipated to satisfactorily fulfill construction demands. Federal transportation funds, the Transportation Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) provides outside funding assistance for urban arterial and rural arterial projects. The Federal Aid Bridge Replacement Program and the Federal Aid Safety Program are also available under SAFETEA-LU. These funds replace deficient bridges and provide signal and gate protection for railroad grade crossings. The Rural Arterial Program administered through the County Road Administration Board provides some funding for improvement of rural arterials.

Supplemental section programs in the 2012-2017 Six-Year Construction Program are also included. The Urban Arterial Supplemental Section Program (UCPUAP) is a continuation of the previously funded program for the major improvement of arterials in urban areas. The Rural Arterial Supplemental Section Program (RAP) is the continuing program for the improvement of rural county arterials. Much like the urban program, rural arterial funded projects will be selected on a regional competitive priority basis. The County Arterial Preservation Program (CAPP) is a continuing program for pavement restoration on county arterials.

The Six-Year Transportation Improvement Program includes projects throughout the County. In both the urban and rural areas, major emphasis is placed on cost efficient traveled-way improvements for the existing roads. Annually recurring projects, such as pathway projects, small bridge projects, preservation projects, traffic control sign and signal projects, traffic safety studies and minor construction projects, are also included in the Six-Year Transportation Improvement Program.

The Program includes an indication of environmental determination for each project.

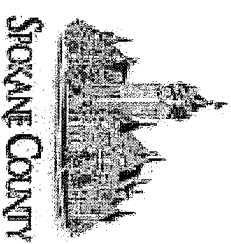
The initial environmental assessment was made on the effect of the project to the local area and to the general public, taking into account such considerations as right of way acquisition, effect of clearing and grading, changes in natural drainage and possible disruptions to neighborhoods. Proposed projects have been indicated as having a "Not significant" environmental effect (designated by "N") or of requiring additional study (marked "S"). These projects for which additional study is indicated will be reviewed with particular attention to the sensitive areas at the time of preliminary design. At that time, a further declaration may be made before proceeding with the project.

The Annual Road Construction Program is a listing of those projects proposed for construction during 2012. It includes 2 major items and involves a total of \$14,133,000 in Road funds, \$3,111,000 in County funds, \$4,769,000 of Federal Aid Funds, \$918,000 in CAPP funds, \$162,000 in TIB's Sidewalk Program funds, \$83,000 in RAP funds, \$315,000 in other state funds, and \$4,775,000 in private fund participation and property owner approved assessments. During 2012 for each County dollar spent, a total of \$4.54 of construction will be accomplished.

The major urban projects in the 2012 Annual Program are the design and construction of the Thomas Mallen TIF Project and the design and construction of the Little Spokane River Bridge at Dartford Drive. In addition there are the following pathway projects: The Wandermere Road pathway Project, the Whitworth Drive Sidewalk Project, the Northwoods & Farwell School Safety Project, the Pasadena Park Elementary School Pathway Project, the design of the Centennial Trail Grade Separation at Argonne Road and the construction of the Centennial Trail Realignment at Gateway Park. The major rural projects in the 2012 Annual Program are design and right-of-way work on Bigelow Gulch Road from the Urban Boundary to East Welle Road and Bigelow Gulch from East Welle to Jensen Road. Rural Improvement District work consists of the final shot of BST on the Kenney-Smythe-Stutler RID and the Stentz RID and construction of the Colonial-6th-Glenbrook-Cloverdale RID project.

Similar to the Six-Year Program, each project of the Annual Program has indicated an environmental assessment. Those projects, with the initial environmental assessment indicated as having slight environmental effects, have been identified as "Not significant" (designated by "N"). Those projects that have indications involving environmental concerns have been recommended for further study and are designated as "S". After more detailed information is available on the project, a further recommendation will be made to the Board regarding the environmental significance of each project.

The Six-Year Program breaks down each funding source as either secured or unsecured funding. The project sources that have funding secured by either County Road Funds or secured grants are check in the secured funding box. Project funding sources that have not yet been secured do not have the funding box checked.



Spokane County
Department of Public Works
Engineering Division
2012 - 2017 Six Year Transportation Improvement Program
2012 - 2017 County Road Fund Budget Forecasts

Six Year Transportation Improvement Program

<u>Revenue</u>	<u>Budget Revenue</u>					
	<u>2012</u>	<u>2013</u>	<u>2014</u>	<u>2015</u>	<u>2016</u>	<u>2017</u>
Designated Funds	7,277,260	\$3,999,815	\$4,000,000	\$4,000,000	\$4,000,000	\$4,000,000
Property Tax	15,433,000	\$15,503,000	\$15,556,000	\$16,164,000	\$16,487,000	\$16,982,000
Fuel Tax	8,938,000	\$8,938,000	\$8,938,000	\$8,938,000	\$8,938,000	\$9,000,000
IF Transfer 010 REET	1,325,000	\$1,325,000	\$1,325,000	\$1,325,000	\$1,325,000	\$1,325,000
Misc. Tax Revenue	62,400	\$62,000	\$62,000	\$62,000	\$62,000	\$62,000
Reimbursable (Permit/Fees/Sales/Engineering & Maintenance) Revenue	1,484,500	\$1,500,000	\$1,500,000	\$1,500,000	\$1,500,000	\$1,500,000
Grant Revenue (Federal/State/CRAB/Other)	6,266,420	\$8,351,000	\$14,199,000	\$17,560,000	\$19,023,000	\$9,567,000
IF Transfers (other County Funds) and Misc.	4,074,000	\$1,038,000	\$1,097,000	\$1,097,000	\$1,097,000	\$1,097,000
Total	\$44,860,580	\$40,716,815	\$46,677,000	\$50,646,000	\$52,432,000	\$43,533,000
<u>Expenditures</u>	<u>Budget Expenditures</u>					
	<u>2012</u>	<u>2013</u>	<u>2014</u>	<u>2015</u>	<u>2016</u>	<u>2017</u>
Fund Carryover	\$3,999,815	\$4,000,000	\$4,000,000	\$4,000,000	\$4,000,000	\$4,000,000
Reimbursables	\$2,945,243	\$965,000	\$965,000	\$965,000	\$965,000	\$965,000
Administration (Indl. Cost Allow, Insurance, Indirect Labor, etc.)	\$6,776,895	\$6,500,000	\$6,700,000	\$6,900,000	\$7,100,000	\$7,300,000
Debt Service	\$822,185	\$815,000	\$816,000	\$814,000	\$796,000	\$803,000
City of Spokane Valley Contract	\$450,000	\$450,000	\$450,000	\$450,000	\$450,000	\$450,000
Construction	\$13,215,000	\$10,605,000	\$17,190,000	\$20,264,000	\$21,012,000	\$11,651,000
Maintenance	\$9,146,422	\$9,421,000	\$9,704,000	\$9,995,000	\$10,295,000	\$10,604,000
Preservation	\$7,505,020	\$7,960,815	\$6,852,000	\$7,258,000	\$7,814,000	\$7,760,000
Total	\$44,860,580	\$40,716,815	\$46,677,000	\$50,646,000	\$52,432,000	\$43,533,000

GLOSSARY AND ABBREVIATIONS

Functional Classification:

Rural:	
7	Major Collector
8	Minor Collector
9	Access
Urban:	
14	Principal
16	Minor
17	Collector
19	Access

Program Item Number: A number assigned for tracking purposes

Work Method:

C- Indicates work is to be done by contract
F- Indicates work to be done by County forces.
N- Indicates a non-capital project.

Environmental:

S- Significant Impacts under SEPA anticipated
I- Insignificant Environmental Impact anticipated

Work Types:

New construction	01
Relocation	02
Reconstruction	03
Major Widening	04
Minor Widening	05
Other Enhancements	06
New Bridge Const	08
Bridge Replacement	09
Bridge Rehabilitation	10
Minor Bridge Rehab	11
Safety/Traffic Oper/TSM	12

Environmentally Related	13
Bridge Program Special	14
Transit Capital Project	21
Transit Operational Project	22
Transit Planning	23
Transit training/Admin	24
Non-Capital Improve.	31
Non Motor Vehicle	32

CO:

Box is checked if the project lies within the Carbon Monoxide non-attainment area

Fund Status:

S- Project is subject to funding selection
P- Project is listed for planning purposes only

Util Code:

Utilities that would be impacted by the project:
C Cable TV
G Gas
O Other
P Power
S Sewer
T Telephone
W Water

Funding Sources:

Federal assistance: These funds are authorized under the Transportation Equity Act for the 21st Century (TEA-21) and are administered by the Federal Highway Administration through the Washington State Department of Transportation and the Metropolitan Planning Organization (SRTC).
BR- Bridge replacement projects
CMAQ- Congestion Management and Air Quality
Other Fed- Other federal funds.
Other - Private Funding sources, loans or materials acquired from other sources. For the South Hill Park &

Ride Study - Other is Spokane Transit Authority. For the Gieger Rail Rehabilitation - Hayford to Craig Rd. - Other is \$50,000 in rails salvaged from another project and a loan from the State of Washington for \$ 180,000.

STP- Surface Transportation Program. Individual funds are designated by the letters in parenthesis that follow the initials "STP":

- (U) Urban improvements
- (R) Rural improvements
- (C) Competitive funding
- (E) Enhancement improvement
- (S) Safety improvements

State assistance: UCP, UAP, and SP are

administered by the Transportation Improvement Board. RAP and CAPP are administered by the County Road Administration Board
UCP- Urban Corridor Program
UAP- Urban Arterial Program
SP- Urban Sidewalk Program
RAP- Rural Arterial Program
CAPP- County Arterial Preservation Program
FMSIB- Freight Mobility Strategic Investment Board Program
Other State- Other state funds

Local funding: RID Bonds are sold to finance the construction of local roads. This funding is administered by Spokane County. Private funds are paid by private companies or individuals for various reasons, usually for commercial reasons.

RID Bonds- Road Improvement District funding from private property owners.

Private- Funds from other private sources.

County- Funds collected by Spokane County primarily from the road tax and state gasoline tax.

SUMMARY 2012 ANNUAL ROAD CONSTRUCTION PROGRAM

The CONSTRUCTION PROGRAM is responsible for the improvement of the County Transportation System. ANNUAL and SIX YEAR CONSTRUCTION PROGRAMS are prepared and updated each year. Priority programming is used to select both Urban and Rural projects for improvement. Funds for the 2012 ANNUAL ROAD CONSTRUCTION PROGRAM come from the following sources:

Source	Amount (1000s)
County (Includes REET and PWTFF Funds)	\$3,111
Federal	\$4,769
State	\$1,478
Assessment	\$1,240
Other	\$3,535
Total Construction	\$14,133

Note: For each COUNTY dollar spent, a total of \$4.54 of CONSTRUCTION will be accomplished.

2012 Major Construction Project Summary

Project	From	To	Primary Source	Amount
1 Thomas Mallen TIF Project			Other	\$3,000,000
2 Urban Arterial Preservation Projects			CAPP	\$918,000
3 Wandermere Road Pathway	WSDOT Turnback line & .	Dartford Road	STP(E)	\$324,000
4 Northwoods & Farwell School Safety Project	Pittsburg Street	Crestline Street	Other Fed	\$360,000
5 Pasadena Park Elementary School Pathway Pro	Farwell Road	Center Street	Other Fed	\$412,000
	Dick Road	Bessie Road		
	Pasadena Elem School	Maquerite Road		
6 Centennial Trail Realignment at Gateway Park			Other	\$288,000
7 Centennial Trail Realignment at Gateway Park			Other State	\$288,000
8 Little Spokane River Bridge # 3602	BR #3602 Over Little Spo		BR	\$2,113,000
9 Bruce Road Bridge No. 3604			BR	\$290,000
10 Bigelow Gulch/Forker Rd - ROW Mitigation - Rur			County	\$796,000
11 Inland Road	Seven Mile Road	Old Trail Road	STP(R)	\$290,000
	Inland Road	Marstrand Lane		
12 Geiger Rail Rehabilitation - Hayford to Craig Rd.			Other State	\$383,000

Division of Engineering
Department of Public Works
2012 - 2017 Six Year Transportation Improvement Program
2012 Annual Construction Program

Hearing Date: 10/25/2011 Adoption Date: 10/25/2011
 Env. Assess. Date: 10/25/2011 Resolution No.:

Dollars in thousands

Program Item	Func Class	Project Name Road Names Work Scope Status	From	To	Road #	Proj #	Envr Length(mi)	Work Type	Fund C	Work O	Fund Meth	Sec Fund	Source	Fed Funds	State Funds	Other Funds	County Funds	P.E.	R.W.	Const	Total
Urban Construction																					
1		South Hill Park & Ride Study				3129	1	06	<input checked="" type="checkbox"/>	S		TCGPWS									
This project is a cooperative planning and design project between Spokane County and Spokane Transit Authority. The project objective is to study and review the size, type, and location for a Transit Park and Ride and supportive infrastructure. The concept of this project is to provide a park and ride lot in the study area that will allow a shorter distance to travel in single occupant vehicles to access transit. Prelim. Engineering																					
									C		<input checked="" type="checkbox"/>	County		15			15	0	0	0	15
									C		<input checked="" type="checkbox"/>	CMAQ		195			195	0	0	0	195
									C		<input checked="" type="checkbox"/>	Other		15			15	0	0	0	15
														225			225	0	0	0	225
2		Waikiki / Mill Road Intersection Improvements				3119	1	06	<input checked="" type="checkbox"/>	S		TCGPWS									
This project will construct channelization at the existing Waikiki/Mill Intersection in order to improve the eastbound left turning movement capacity. A refuge lane will be constructed for the eastbound to northbound traffic in the area where an existing traffic island exists and where a left turn lane exists for southbound traffic turning into Woodway. From the refuge lane, traffic will merge into the northbound traffic. Woodway would become a right in/right out only intersection. Existing left turns into and out of Woodway will be required to use the Regina Intersection to the north or other routes. By providing a refuge lane for this eastbound left turn movement, it should increase the capacity since the eastbound left turning traffic will only have to avoid conflicts with the southbound traffic and the northbound left turning traffic. Prelim. Engineering																					
									C		<input checked="" type="checkbox"/>	Other				1		1	0	0	1
																		1	0	0	1

**Division of Engineering
Department of Public Works
2012 - 2017 Six Year Transportation Improvement Program
2012 Annual Construction Program**

Hearing Date: 10/25/2011 Adoption Date: 10/25/2011
Env. Assess. Date: 10/25/2011 Resolution No.:

Dollars in thousands

Program Item	Func Class	Project Name		From	To	Road #	Proj #	Envir Len(m)	Fund Stat		Fed Funds	State Funds	Other Funds	County Funds	P.E.	R.W.	Const	Total
		Road Names	Work Scope						Type	O Meth								
3		Liberty Lake TIF & LIFT					3130	1	01	<input checked="" type="checkbox"/> S								
This CRP is established to administer Spokane County Engineering's responsibilities associated with terms of the Liberty Lake TIF & LIFT(Spokane County River District Revenue Development Area at Liberty Lake).																		
Prelim. Engineering																		
4		Bigelow Gulch/ Forker Rd - ROW Mitigation - Urban						1	06	<input type="checkbox"/> S								
Mitigate ROW issues in accordance with rules & regulations.																		
Right-of-Way																		
5		Little Spokane River Bridge 3602						3085	1	06	<input type="checkbox"/> S							
	16	Little Spokane Dr	Dartford Drive	350' after BR 3602	02570			0.10										
	17	Dartford Drive	Wandermere Road	300' after Mill Road	00823			0.19										
	14	Mill Road	175 feet before Dartford	Dartford Drive	03036			0.05										
This proposal involves the approach road work tied to replacement of BR 3602. CPR 3063 on Little Spokane Drive, including the realignment of the Dartford, Mill and Little Spokane Drive intersection, both horizontally and vertically. Typical cross section includes 32 feet of roadway and 10 feet of paved shared use pathway along Little Spokane and Dartford, Mill Road consists of 45 feet of roadway and 6 feet of concrete sidewalk.																		
Prelim. Engineering, Right-of-Way, Construction																		

Division of Engineering
Department of Public Works
2012 - 2017 Six Year Transportation Improvement Program
2012 Annual Construction Program

Dollars in thousands

Hearing Date: 10/25/2011 Adoption Date: 10/25/2011
 Env. Assess. Date: 10/25/2011 Resolution No.:

Program Item	Func Class	Project Name Road Names Work Scope Status	From	To	Road #	Proj #	Envir Len(m)	Work Type	Fund C Work O Meth	Fund Sec Fund Source	Fed Funds	State Funds	Other Funds	County Funds	P.E.	R.W.	Const	Total
6		Thomas Mallen TIF Project				3117	1	04	<input checked="" type="checkbox"/> S	TCGPWS								
						0.00												
This project is being set up to track costs associated with the Thomas Mallen TIF project which plans to widen and improve Thomas Mallen Road for the Aircraft Museum.																		
Prelim. Engineering, Construction																		
7		Harvard Road Reconstruction				3078	1	03	<input type="checkbox"/> P									
		14 Harvard Rd	Euclid Avenue		SR 290	01741	1.60											
									C	<input checked="" type="checkbox"/> County				14	14	0	0	14
									C	<input checked="" type="checkbox"/> STP(U)	86			86	86	0	0	86
														100	100	0	0	100
Reconstruct and widen roadway.																		
Prelim. Engineering																		
8		Hallett Road at Westbow Road TIF				3135	1	01	<input checked="" type="checkbox"/> S	TCGPWS								
		17 Hallett Road	Westbow Road		Thomas Mallen Road	01706	0.75											
									C	<input checked="" type="checkbox"/> County				214	10	0	204	214
														10	10	0	204	214
This project will construct frontage improvements on Hallett Road with TIF funds as part of the development of the Caterpillar Inc. site. Construction of the sidewalk at the site will be the responsibility of the developers.																		
Prelim. Engineering, Construction																		
9		Country Homes Stormwater Project				1	06	<input checked="" type="checkbox"/> S		TCGPWS								
									C	<input checked="" type="checkbox"/> Other				133	133	0	0	133
														133	133	0	0	133
This project will install pipes for the stormwater flow in the asphalt ditch on Country Homes Blvd, landscaping and other improvements.																		
Prelim. Engineering																		

Hearing Date:	10/25/2011	Adoption Date:	10/25/2011
Env. Assess. Date:	10/25/2011	Resolution No.:	

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Program Item	Funct Class	Project Name Road Names Work Scope Status	From	To	Road #	Proj #	Envr Len(m)	Work Type	C O Meth	Fund Sec	Fund Source	Fed Funds	State Funds	Other Funds	County Funds	P.E.	R.W.	Const	Total
10		Argonne Road Reconstruction Project																	
	14	Argonne Road	Wellesley Ave.	Bigelow Gulch Road	00091	3112	1	03	<input checked="" type="checkbox"/>	S	TCGPWS								
										C	<input checked="" type="checkbox"/> County				29	29	0	0	29
										C	<input checked="" type="checkbox"/> STP(U)	90				90	0	0	90
																119	0	0	119
This project proposes to reconstruct approximately 1.64 miles of roadway from the Urban Boundary to Wellesley Ave. with 4" of HMA and 10" of cement modified soil. Minor drainage improvements will be included in the contract.																			
Prelim. Engineering																			
11		Urban Arterial Preservation Projects					1	03	<input checked="" type="checkbox"/>	S									
		Rehabilitate existing arterials.								C	<input checked="" type="checkbox"/> CAPP		918			20	0	898	918
																20	0	898	918
Prelim. Engineering, Construction																			
12		Sewer Pavement					1	06	<input checked="" type="checkbox"/>	S									
		Various roads					0.00			C	<input checked="" type="checkbox"/> County				430	0	0	430	430
		Resurface arterial and residential roads after sewer construction.														0	0	430	430
Milica View Sewer Pavement Project Close Out																			
13		Minor Urban Projects					1	06	<input checked="" type="checkbox"/>	S									
		Minor improvements at various locations.								C	<input checked="" type="checkbox"/> County				100	10	10	80	100
		Prelim. Engineering, Right-of-Way, Construction														10	10	80	100

Division of Engineering
Department of Public Works

Hearing Date: 10/25/2011 Adoption Date: 10/25/2011
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2012 - 2017 Six Year Transportation Improvement Program
2012 Annual Construction Program

Dollars in thousands

Program Item	Func Class	Project Name Road Names Work Scope Status	From	To	Road #	Proj #	Envir Len(m)	Work Type	Fund C Work O Meth	Fund Sec	Fund Source	Fed Funds	State Funds	Other Funds	County Funds	P.E.	R.W.	Const	Total
Urban Construction Projects		Total:										422	918	3,159	888	784	115	4,588	5,495

**Division of Engineering
Department of Public Works
2012 - 2017 Six Year Transportation Improvement Program
2012 Annual Construction Program**

Dollars in thousands

Hearing Date: 10/25/2011 Adoption Date: 10/25/2011
Env. Assess. Date: 10/25/2011 Resolution No.:

Program Item	Func Class	Project Name Road Names Work Scope Status	From	To	Road #	Proj #	Envr Length(mi)	Work Type	Fund Stat	Fund C Work	Fund Meth	Fund Sec	Fund Source	Fed Funds	State Funds	Other Funds	County Funds	P.E.	R.W.	Const	Total
Pathway Construction																					
14		Wandermore Road Pathway																			
07		Wandermore Road	WSDOT Turnback line & Dartford Road		05199		0.56	I	<input checked="" type="checkbox"/>	S			TCGPWS				112	0	0	112	112
									C		<input checked="" type="checkbox"/>	County		212			112	20	0	192	212
										<input checked="" type="checkbox"/>	STP(E)						20	0	0	304	324
This project will construct a ten foot wide separated shared use pedestrian pathway along the east side of Wandermore Road from Farwell Road to the intersection of Dartford/Wandermore Road and on the north side of Dartford Road from Wandermore Rd. to the Mill Rd/Dartford/Little Spokane Intersection.																					
Prelim. Engineering, Construction																					
15		Whitworth Drive Sidewalks																			
		Whitworth Drive	770E of Walkiki Rd.		College Entrance Roa	05285		0.29	I	<input checked="" type="checkbox"/>	S		TCGPWS				40	0	0	40	40
									C		<input checked="" type="checkbox"/>	County		162			0	0	0	162	162
										<input checked="" type="checkbox"/>	SP						0	0	0	202	202
Construct cement concrete sidewalks along the North side of Whitworth Drive.																					
Construction																					
16		Northwoods & Farwell School Safety Project																			
14		Farwell Rd	Pittsburg Street		Cresline Street	01323		0.25	I	<input checked="" type="checkbox"/>	S		TCGPWS				22	0	0	0	22
19		Cresline Street	Farwell Road		Center Street	00659		0.25					County				22	0	0	0	22
									C		<input checked="" type="checkbox"/>	County		318			0	0	0	318	318
									C		<input checked="" type="checkbox"/>	Other Fed					0	0	0	20	20
									C		<input checked="" type="checkbox"/>	Other					22	0	0	338	360
This project will install a traffic signal at the Pittsburg / Farwell Intersection along with crosswalks. A mid-block crosswalk will be installed approximately 200' south of the Center / Farwell Intersection. A sidewalk and crosswalk will be installed from Carlson Court to the Children of the Sun Trail entrance / Farwell School entrance.																					
Prelim. Engineering, Construction																					

Hearing Date:	10/25/2011	Adoption Date:	10/25/2011
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Program Item	Funct Class	Project Name Road Names Work Scope Status	From	To	Road #	Proj #	Envir Lent(m)	Work Type	C Meth	Fund Sec	Fund Source	Fed Funds	State Funds	Other Funds	County Funds	P.E.	R.W.	Const	Total
17		Pasadena Park Elementary School Pathway Project																	
16	Upriver Drive	Dick Road		Bessie Road	05014	3133	1	01	<input checked="" type="checkbox"/>	S	CGPTWS								
16	Upriver Drive	Pasadena Elem School		Marguerite Road	05014		0.28		0.27										
19	Marguerite Road				02870		0.04												
	Add pathway along Upriver Drive and Marguerite Road.																		
18		Prelim. Engineering, Right-of-Way, Construction																	
	Centennial Trail at Argonne Road																		
			I					01	<input checked="" type="checkbox"/>	S									
				C					<input checked="" type="checkbox"/>	STP(E)		99				95	4	0	99
	Grade separate trail at Argonne Road by going under the north abutment of the Argonne Road bridge.															95	4	0	99
19		Prelim. Engineering, Right-of-Way																	
	Centennial Trail Realignment at Gateway Park																		
						3094	I	02	<input type="checkbox"/>	S	TCGPWS								
				C						<input checked="" type="checkbox"/>	Other State		144			12	0	132	144
				C						<input checked="" type="checkbox"/>	Other		144			12	0	132	144
	This project will realign part of the Centennial Trail to pass safely beneath the new Old I-80 Bridge #5515. The realignment will eliminate 2 dangerous at grade trail and road intersections; re-route a shared road segment, and provide direct access to the new underpass and bridge.															24	0	284	288
	Prelim. Engineering, Construction																		
20		Arterial Sidewalks & Pathways																	
			I					06	<input checked="" type="checkbox"/>	S									
				C						<input checked="" type="checkbox"/>	County				40	5	0	35	40
	Construct sidewalks along various arterials															5	0	35	40
	Prelim. Engineering, Construction																		

Division of Engineering
Department of Public Works
2012 - 2017 Six Year Transportation Improvement Program
2012 Annual Construction Program

Hearing Date: 10/25/2011 Adoption Date: 10/25/2011
 Env. Assess. Date: 10/25/2011 Resolution No.:

Dollars in thousands

Program Item	Func Class	Project Name Road Names Work Scope Status	From	To	Road #	Proj #	Fund			Fed Funds	State Funds	Other Funds	County Funds	P.E.	R.W.	Const	Total
							Envir Len(m)	Work Type	Fund C Meth								
Pathway Construction Projects																	Total:
										1,041	308	164	214	183	7	1,535	1,725

**Division of Engineering
Department of Public Works
2012 - 2017 Six Year Transportation Improvement Program
2012 Annual Construction Program**

Heating Date: 10/25/2011 Adoption Date: 10/25/2011
Env. Assess. Date: 10/25/2011 Resolution No.:

Dollars in thousands

Program Item			Project Name Road Names Work Scope Status			Fund Stat C Work Fund Sec Fund Source Funds Fed Funds State Funds Other Funds County Funds P.E. R.W. Const Total																
Func Class			From	To	Road #	Proj #	Envir Len(m)	Work Type	O Meth													
Road Improvement Districts																						
21	Kennedy - Smythe - Stutler RID																					
09	Kennedy Road		Smythe Road	Paradise Road	02307		0.93		<input type="checkbox"/> S		TCGPO											
09	Smythe Road		375' s of Dynamite Lane	Paradise Road	04506		1.95															
09	Stutler Road		Keeney Road	East approx 425 feet	04595		0.09		F	<input checked="" type="checkbox"/> County								26	7	0	19	26
									F	<input checked="" type="checkbox"/> RID Bonds								148	40	0	108	148
	Day labor BST pave a minimum 24' finished hard surface with (2) 1' gravel shoulders.																		47	0	127	174
Second shot of BST & close out																						
22	Stentz RID																					
09	Stentz Road		Miller Rd. Y	1 Mile Plus	04573		1.01		<input type="checkbox"/> S		TGP							10	3	0	7	10
									F	<input checked="" type="checkbox"/> County								54	16	0	38	64
									F	<input checked="" type="checkbox"/> RID Bonds								19	0	45	64	
Day Labor BST pave a minimum 24' finished hard surface with (2) 1' gravel shoulders.																						
Second shot of BST and close out																						
23	Colonial - 6th - Glenbrook - Cloverdale (Micaview)																					
19	Glenbrook Street		8th Avenue	Micaview Drive	01611		0.34		<input type="checkbox"/> S		TCGPWS											
19	Cloverdale Court		W End to Glenbrook Str	Glenbrook Street	00755		0.10															
19	Colonial Dr		Micaview Drive	8th Avenue	00749		0.22															
19	6th Avenue		Colonial Drive	Glenbrook Street	06177		0.15		C	<input checked="" type="checkbox"/> County								3	3	0	0	3
	Contract HMA pave										C	<input checked="" type="checkbox"/> RID Bonds							18	0	0	18
	Close out																		21	0	0	21

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Dollars in thousands

Project Name			Fund		
Program	Road Names	Work Scope	Stat		
Item	Class	Status	From	To	
			Road #	Proj #	
			Envir Len(m)	Work Type	Fund C Work O Meth
					Sec Fund Source
					Fed Funds
					State Funds
					Other Funds
					County Funds
					P.E.
					R.W.
					Const
					Total
24	Various RID Projects			1	03
	Various roads		0.00		<input checked="" type="checkbox"/> S
					C
					<input checked="" type="checkbox"/> County
					<input checked="" type="checkbox"/> RID Bonds
	Reconstruct gravel roads.				
					1,020
					60
					0
					120
					180
					340
					0
					880
					1,020
					400
					0
					800
					1,200
Prelim. Engineering, Construction					
Road Improvement Districts Projects Total:			1,240	219	487
			0	972	1,459

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Program Item	Func Class	Project Name Road Name Work Scope Status	From	To	Road #	Proj #	Envir Len(m)	Work Type	Fund C Meth	Fund Source	Fed Funds	State Funds	Other Funds	County Funds	P.E.	R.W.	Const	Total
Traffic Safety Improvements																		
25		Monroe Road Safety Project				3125A	I	01	<input type="checkbox"/>	S	TCGP							
	07	Monroe Rd	US Hwy 395 at Dartford	Crawford St. at US 39	03066	11.72												
This project is the 2nd Phase of installing improvements on Monroe Road from US 395 near Dartford to US 395 at Deer Park. Improvements include installation of guardrail, a flashing beacon at the Monroe/Hazard intersection, edge line striping, and signage improvements to address safety concerns.																		
		Construction																
26		Palouse Road Safety Project				3125B	I	01	<input type="checkbox"/>	S								
		Various safety projects.																
		Construction																
27		Glennrose Safety Project				3125C	I	01	<input type="checkbox"/>	S								
		Various safety improvements.																
		Construction																
28		Cheney-Spokane Road Safety Project				3125D	I	01	<input type="checkbox"/>	S								
		Various safety improvements.																
		Construction																

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Program Item	Func Class	Project Name Road Names Work Scope Status	From	To	Road #	Proj #	Envr Len(m)	Work C Type	Fund Stat	Fund					P.E.	R.W.	Const	Total
										Fund	Source	Funds	Funds	Funds				
Traffic Safety Improvements Projects Total:										729			0	0	729	729		

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Program Item	Func Class	Project Name Road Names Work Scope Status	From	To	Road #	Proj #	Envir Len(m)	Work Type	Fund C Meth	Fund O Meth	Fund Sec	Fund Source	Fed Funds	State Funds	Other Funds	County Funds	P.E.	R.W.	Const	Total
Bridge Construction																				
29		Little Spokane River Bridge # 3602																		
16		Little Spokane Dr	BR #3602 Over Little Sp		02570	3063	1	01	<input checked="" type="checkbox"/>	S	TS									
		This proposal involves construction of a new prestressed concrete bridge approximately 45' wide and 106' long accompanied by removal of the existing bridge. The bridge width will accommodate 10' of shared use path. The new bridge will be constructed in the footprint of the existing with intersection improvements at the south approach.																		
		Prelim. Engineering, Construction																		
30		Old 140 Over Spokane River Bridge	@ Spokane River	#5515	00121	3014	1	10	<input type="checkbox"/>	S										
14		Appleway Road					0.24													
		Replace existing bridge with a new concrete structure. Project scope is set and public meeting complete. Replacement bridge is approximately 45' wide and 490 feet long. Approach work will avoid intersection of Appleway and Spokane Bridge Road. Bridge section carries (2) - 12' traffic lanes, (2) - 4' shoulders, and a 10' shared use path.																		
		Construction																		
31		Bruce Road Bridge No. 3604				3126	1	03	<input type="checkbox"/>	S										
		Proposed is a new prestressed concrete bridge approximately 100 feet long and 40 feet wide. The existing will be removed and the new constructed in its footprint. No horizontal alignment change is anticipated. The vertical alignment will be studied.																		
		Prelim. Engineering, Right-of-Way																		
									C		<input checked="" type="checkbox"/>	County				58	56	2	0	58
									C		<input checked="" type="checkbox"/>	BR	232				224	8	0	232
																	280	10	0	290

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Program Item	Funct Class	Project Name		From	To	Road #	Proj #	Fund		Fed Funds	State Funds	Other Funds	County Funds	P.E.	R.W.	Const	Total
		Road Names	Work Scope Status					Envir Len(m)	Work C Type								
32		Cheney- Plaza Bridge #2108						1	03 <input type="checkbox"/> S								
	07	Cheney Plaza		@ Bonnie Creek		00577		0.01									
		Replace existing bridge.							C <input checked="" type="checkbox"/> County				180	30	0	150	180
													30	0	0	150	180
33		Prelim. Engineering, Construction															
		Small Bridge Improvements							11 <input type="checkbox"/> S								
		Various roads.															
		Bridge Improvements at various locations.							C <input checked="" type="checkbox"/> County				25	5	0	20	25
		Prelim. Engineering, Construction															
		Bridge Construction Projects Total:								2,118			735	350	10	2,481	2,851

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Program Item	Func Class	Project Name Road Names Work Scope Status	From	To	Road #	Proj #	Envir Len(mi)	Work Type	C Work O Meth	Fund Sec	Fund Source	Fed Funds	State Funds	Other Funds	County Funds	P.E.	R.W.	Const	Total
Rural Construction																			
34		Bigelow Gulch/Forker Rd - ROW Mitigation - Rural						I	06	<input type="checkbox"/> S									
		Mitigate ROW issues in accordance with rules & regulations.								<input checked="" type="checkbox"/> County		796	0	796	0	796			796
												0	0	796	0	796			796
Right-of-Way																			
35		Bigelow Gulch/Forker Connector - Project 2				2620		S	03	<input type="checkbox"/> P	PT								
	07	Bigelow Gulch Road	Urban Boundary	East Welle Road	00263		1.32			C	<input checked="" type="checkbox"/> STP(R)	110				10	100	0	110
		Reconstruct and widen to four lanes with shoulders.								C	<input checked="" type="checkbox"/> RAP	20				20	0	0	20
												30	100	0	0	130			130
Prelim. Engineering, Right-of-Way																			
36		Bigelow Gulch/Forker Connector - Project 3				2624		S	03	<input type="checkbox"/> P	PT								
	07	Bigelow Gulch Road	E. Welle Road	Jensen Road	00263		1.20			C	<input checked="" type="checkbox"/> County	15				2	13	0	15
		Reconstruct roadway and widen to four lanes with shoulders.								C	<input type="checkbox"/> Other Fed	100				13	87	0	100
												15	100	0	115				115
Prelim. Engineering, Right-of-Way																			
37		Bigelow Gulch/Forker Connector - Project 4				2689		S	03	<input type="checkbox"/> P	TGP								
	07	Bigelow Gulch Road	Old Argonne Road	Forker Road	00263		2.91			C	<input checked="" type="checkbox"/> County	1				1	0	0	1
		Reconstruct and widen to a 4-lane road with 8-foot shoulders and a 12 foot median.								C	<input checked="" type="checkbox"/> RAP	9				9	0	0	9
												10	0	0	0	10			10
		Prelim. Engineering																	

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38	07	Bigelow Gulch/Forker Connector - Project 5 Forker Road	Bigelow Gulch Rd (end)	Progress Road	01349	2990	0.95	S	03	<input type="checkbox"/>	P	TGP	C	<input checked="" type="checkbox"/> County <input checked="" type="checkbox"/> RAP	54	6	5	1	0	0	6
Reconstruct and widen to a 4-lane road with 8-foot shoulders and a 12 foot turn-lane where necessary																					
Prelim. Engineering, Right-of-Way																					
39	09	Inland Road Inland Road Old Trails Rd	Seven Mile Road Inland Road	Old Trail Road Marchand Lane	02035 82347	0.49	1.49	I	03	<input type="checkbox"/>	P	C	<input checked="" type="checkbox"/> County <input type="checkbox"/> STP(R)	251	39	39	251	0	0	0	39
Reconstruct and widen to 36 feet from Seven Mile Road to Marchand Lane.																					
Prelim. Engineering																					
40	Minor Rural Projects Various roads					I	0.00	03	<input type="checkbox"/>	S	C	<input checked="" type="checkbox"/> County	100	10	10	80	10	80	100	100	
Minor improvements at various locations.																					
Prelim. Engineering, Right-of-Way, Construction																					
Rural Construction Projects Total:													461	83	957	405	1,016	80	1,501		

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Program Item	Func Class	Project Name Road Names Work Scope Status	From	To	Fund		Envir	Work C	Fund	Fed Funds	State Funds	Other Funds	County Funds	P.E.	R.W.	Const	Total
					Stat	Stat											
					Road #	Proj #	Len(m)	Type	O Meth	Sec Fund Source							

3134 1 06 ☒ S

171	212	0	0	383	383
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4,769	1,478	4,775	3,111	2,209	1,148	10,776	14,133
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Program Item	Func Class	Project Name		Fund		Fed Funds	State Funds	Other Funds	County Funds	P.E.	R.W.	Const	Total
		Road Names	Work Scope	Stat	Fund								
		From	To	Road #	Proj #	Envir Len(m)	Work Type	C Work O Meth	Sec Fund	Source			

1 Little Spokane River Bridge 3602

This proposal involves the approach road work tied to replacement of BR 3502, CPR 3065 on Little Spokane Drive, including the realignment of the Dardoff, Mill and Little Spokane Drive intersection, both horizontally and vertically. Typical cross section includes 32 feet of roadway and 10 feet of paved shared use pathway along Little Spokane and Dardoff. Mill Road consists of 45 feet of roadway and 6 feet of concrete sidewalk.

3130	I	01	<input checked="" type="checkbox"/>	S
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This CRP is established to administer Spokane County Engineering's responsibilities associated with terms of the Liberty Lake TIF & LIFT (Spokane County River District Revenue Development Area at Liberty Lake).

14 Farwell Road Cherry Street

Construct a 3-lane roadway with curb, swales and separated sidewalks from Cherry Street (east end of NSC Construction) to Market Street, transition and connect to existing 2-lane at Myrtle Street.

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								Work Type	C Meth	Sec Fund Source								
4	17	Hallett Road at Westbow Road TIF Hallett Road	Westbow Road	Thomas Mallen Road	01706	3135	I 0.75	01	<input checked="" type="checkbox"/>	S	TCGPWS							
									C	<input checked="" type="checkbox"/> County		35	0	0	35	35		
This project will construct frontage improvements on Hallett Road with TIF funds as part of the development of the Caterpillar Inc. site. Construction of the sidewalk at the site will be the responsibility of the developers.																		
Construction																		
5	14	Harvard Road Reconstruction Harvard Rd	Euclid Avenue	SR 290	01741	3078	I 1.60	03	<input type="checkbox"/>	P								
									C	<input checked="" type="checkbox"/> County		6	0	6	0	6		
Reconstruct and widen roadway.																		
37																		
0																		
43																		
0																		
43																		
6	16	32nd Avenue Reconstruction Project 32nd Avenue	Conklin Road	Barker Road	05972	1.52	I	03	<input checked="" type="checkbox"/>	P								
									C	<input checked="" type="checkbox"/> County		42	42	0	0	42		
Reconstruct and widen to 36 feet from Conklin to Barker Road. Improve intersection at Linke Road.																		
268																		
268																		
0																		
310																		
0																		
310																		
7		Minor Urban Projects Minor Urban Projects				I	06	<input checked="" type="checkbox"/>	S									
								C	<input checked="" type="checkbox"/> County		100	10	10	80	100			
Minor improvements at various locations.																		
Prelim. Engineering, Right-of-Way, Construction																		
10																		
80																		
100																		

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8		Urban Arterial Preservation Projects							I	03	<input checked="" type="checkbox"/> S								
		Rehabilitate existing arterials.							C		<input checked="" type="checkbox"/> CAPP		918			20	0	898	918
																20	0	898	918
		Prelim. Engineering, Construction																	
		Urban Construction Projects Total:										3,049	1,320	10	574	350	53	4,550	4,953

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Program Item	Func Class	Project Name Road Names Work Scope Status	From	To	Road #	Proj #	Envr Lent(mi)	Work Type	Fund C Work O Meth	Fund Fund Sec	Fund Fund Source	Fed Funds	State Funds	Other Funds	County Funds	P. E.	R.W.	Const	Total
Pathway Construction																			
9		Arterial Sidewalks & Pathways						I	06	<input checked="" type="checkbox"/>	S								
		Construct sidewalks along various arterials							C	<input checked="" type="checkbox"/>	County				40	5	0	35	40
															5	0	0	35	40
Northwoods & Farwell School Safety Project																			
10		Prelim. Engineering, Construction																	
		Northwoods & Farwell School Safety Project																	
		14 Farwell Rd	Pittsburg Street	Crestline Street	01323		I	01	<input checked="" type="checkbox"/>	S	TCGPWS								
		19 Crestline Street	Farwell Road	Center Street	00659		0.25		C	<input checked="" type="checkbox"/>	STP(S)	56		3	0	0	0	56	66
									C	<input checked="" type="checkbox"/>	Other				0	0	0	3	3
															0	0	0	59	69
This project will install a traffic signal at the Pittsburg / Farwell intersection along with crosswalks. A mid-block crosswalk will be installed approximately 200' south of the Center / Farwell intersection. A sidewalk and crosswalk will be installed from Carlson Court to the Children of the Sun Trail entrance / Farwell School entrance.																			
Construction																			
11		Pasadena Park Elementary School Pathway Project																	
		16 Uphver Drive	Dick Road	Bessie Road	05014		I	01	<input checked="" type="checkbox"/>	S	CGPTWS								
		16 Uphver Drive	Pasadena Elem School	Marguerite Road	05014		0.27		C	<input checked="" type="checkbox"/>	STP(S)	22			0	0	0	22	22
		19 Marguerite Road			02970		0.04		C	<input checked="" type="checkbox"/>	STP(S)				0	0	0	22	22
		Add pathway along Uphver Drive and Marguerite Road.													0	0	0	22	22
		Construction													0	0	0	22	22

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Program Item	Func Class	Project Name		From	To	Road #	Proj #	Fund				Fed Funds	State Funds	Other Funds	County Funds	P.E.	R.W.	Const	Total							
		Road Names	Work Scope					Start	End	Sec	Fund Source															
Pathway Construction Projects Total:																			78		3	40	5	0	118	121

Road Improvement Districts

12	Various RID Projects																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
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Hearing Date:	10/25/2011	Adoption Date:	10/25/2011
Env. Assess. Date:	10/25/2011	Resolution No.:	

Program Item	Funct Class	Project Name Road Names Work Scope Status	From	To	Road #	Proj #	Fund				Fed Funds	State Funds	Other Funds	County Funds	P.E.	R.W.	Const	Total
							Envr' Len(mi)	Work Type	C Work O Meth	Fund Sec								
Traffic Safety Improvements																		

12 Safety Improvement Projects

Minor traffic safety improvements at various locations.

14 Satese & Sullivan Traffic Signal

Traffic Safety Improvements Projects Total:

150	250	16	29	5	362	416
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**Division of Engineering
Department of Public Works
2012 - 2017 Six Year Transportation Improvement Program
2013 Annual Construction Program**

Dollars in thousands

Hearing Date: 10/25/2011 Adoption Date: 10/25/2011
Env. Assess. Date: 10/25/2011 Resolution No.:

Program Item	Func Class	Project Name Road Names Work Scope Status	From	To	Road #	Proj #	Envir Len(mi)	Work Type	Fund C Meth	Fund Stat	Fund Source	Fed Funds	State Funds	Other Funds	County Funds	P.E.	R.W.	Const	Total
Bridge Construction																			
15	08	Rutter Parkway Bridge #2804 Rutter Parkway	Bridge Crossing at MP 3		04218		0.01			10 <input type="checkbox"/> P									
		Rehabilitate existing bridge.								C <input checked="" type="checkbox"/> County		36			9	8	1	0	9
										C <input type="checkbox"/> BR					32	4	0	0	36
												40			5	0	0		45
Prelim. Engineering, Right-of-Way																			
16		Bruce Road Bridge No. 3804				3128	1			03 <input type="checkbox"/> S									
		Proposed is a new prestressed concrete bridge approximately 100 feet long and 40 feet wide. The existing will be removed and the new constructed in its footprint. No horizontal alignment change is anticipated. The vertical alignment will be studied.								C <input type="checkbox"/> County		1,775			444	0	0	444	444
		Construction								C <input checked="" type="checkbox"/> BR					0	0	1,775	1,775	
												0			0	0	2,219	2,219	
Prelim. Engineering, Right-of-Way																			
17	07	Seven Mile Bridge Seven Mile Road	@ Coulee Creek		#1802		0.10			09 <input type="checkbox"/> P					5	4	1	0	5
		Replace existing bridge								C <input checked="" type="checkbox"/> County					4	1	0	0	5
Prelim. Engineering, Right-of-Way																			
18		Small Bridge Improvements Various roads.								11 <input type="checkbox"/> S					25	5	0	20	25
		Bridge improvements at various locations.								C <input checked="" type="checkbox"/> County					5	0	0	20	25
		Prelim. Engineering, Construction													5	0	0	20	25

Division of Engineering
Department of Public Works
2012 - 2017 Six Year Transportation Improvement Program
2013 Annual Construction Program

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Dollars in thousands

Program Item	Func Class	Project Name Road Names Work Scope Status	From	To	Road #	Proj #	Fund Stat				Fed Funds	State Funds	Other Funds	County Funds	P.E.	R.W.	Const	Total
							Envir Len(m)	Work Type	C Work O Meth	Fund Sec								
Bridge Construction Projects Total:										1,811			483	49	8	2,239	2,284	

Division of Engineering
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Dollars in thousands

Program Item	Func Class	Project Name Road Names Work Scope Status	From	To	Road #	Proj #	Envir Len(m)	Work Type	Fund Stat	C Work	Fund Meth	Sec	Fund Source	Fed Funds	State Funds	Other Funds	County Funds	P.E.	R.W.	Const	Total
Rural Construction																					
19		Bigelow Gulch/Forker Connector - Project 4																			
07		Bigelow Gulch Road	Old Argonne Road	Forker Road	00263	2989	S	2.91	03	<input type="checkbox"/>	P		TGP				26	1	25	0	26
									C		<input checked="" type="checkbox"/>	County	RAP		234		9	225	0	234	
		Reconstruct and widen to a 4-lane road with 8-foot shoulders and a 12 foot median.															10	250	0	260	
Prelim. Engineering, Right-of-Way																					
20		Bigelow Gulch/Forker Connector - Project 3																			
07		Bigelow Gulch Road	E. Welle Road	Jensen Road	00263	2924	S	1.20	03	<input type="checkbox"/>	P		PT				103	9	94	0	103
									C		<input checked="" type="checkbox"/>	County	Other Fed	662			56	606	0	662	
		Reconstruct roadway and widen to four lanes with shoulders.															65	700	0	765	
Prelim. Engineering, Right-of-Way																					
21		Inland Road																			
09		Inland Road	Seven Mile Road	Old Trail Road	02035		I	0.49	03	<input type="checkbox"/>	P						7	0	7	0	7
09		Old Trails Rd	Inland Road	Marchand Lane	82347			1.49			C	<input checked="" type="checkbox"/>	County	STP(R)	43		0	0	43	0	43
		Reconstruct and widen to 36 feet from Seven Mile Road to Marchand Lane.															0	50	0	50	
		Right-of-Way																			

**Division of Engineering
Department of Public Works
2012 - 2017 Six Year Transportation Improvement Program
2013 Annual Construction Program**

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Dollars in thousands

Program Item	Func Class	Project Name Road Names Work Scope Status	From	To	Road #	Proj #	Envir Len(m)	Work Type	Fund Stat	Fund C Work O Meth	Fund Sec	Fund Source	Fund Funds	State Funds	Other Funds	County Funds	P.E.	R.W.	Const	Total
22	07	Cheney-Spangle Road Reconstruction Project Cheney-Spangle Rd	Wells Road	Bradshaw Road	00578		2.81	I	03	<input type="checkbox"/> P		<input checked="" type="checkbox"/> County	355			55	55	0	0	65
		Reconstruct and widen from Wells Road to Bradshaw Road.							C	<input type="checkbox"/> STP(R)			355			355	0	0	0	355
													410			410	0	0	0	410
23		Prelim. Engineering Minor Rural Projects Various roads					0.00	I	03	<input type="checkbox"/> S		<input checked="" type="checkbox"/> County				100	10	10	80	100
		Minor Improvements at various locations.														10	10	80	80	100
		Prelim. Engineering, Right-of-Way, Construction																		
		Rural Construction Projects Total:											1,060	234		291	495	1,010	80	1,585

**Division of Engineering
Department of Public Works
2012 - 2017 Six Year Transportation Improvement Program
2013 Annual Construction Program**

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Dollars in thousands

Program Item	Func Class	Project Name Road Names Work Scope Status	From	To	Road #	Proj #	Envir Len(m)	Work Type	Fund C Work O Meth	Fund Sec Fund Source	Fed Funds	State Funds	Other Funds	County Funds	P.E.	R.W.	Const	Total
Rail Freight Construction																		
24		Geiger Rail Rehabilitation - Hayford to Craig Rd.				3134	1	06	<input checked="" type="checkbox"/> S									
Rehabilitate rail line to update ties, ballast and other rail problems.																		
Construction																		
Rail Freight Construction Projects												18	18	0	0	0	36	36
Total:												18	18	0	0	0	36	36

Total Program for 2013	6,146	1,572	1,301	1,594	1,328	1,074	8,203	10,605
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**Division of Engineering
Department of Public Works**

**2012 - 2017 Six Year Transportation Improvement Program
2014 Annual Construction Program**

Dollars in thousands

Hearing Date: 10/25/2011 Adoption Date: 10/25/2011
Env. Assess. Date: 10/25/2011 Resolution No.:

Program Item		Project Name Road Names Work Scope Status			From	To	Road #	Proj #	Envir Len(m)	Work Type	Stat Sheet	Fund C	Work O	Fund Meth	Sec Fund	Source	Funds	Fed Funds	State Funds	Other Funds	County Funds	P.E.	R.W.	Const	Total		
Urban Construction																											
1		Liberty Lake TIF & LIFT						3130	1	01	<input checked="" type="checkbox"/>	S									10	10	10	0	0	0	10
This CRP is established to administer Spokane County Engineering's responsibilities associated with terms of the Liberty Lake TIF & LIFT(Spokane County River District Revenue Development Area at Liberty Lake).																											
Prelim. Engineering																											
2		Harvard Road Reconstruction						3078	1	03	<input type="checkbox"/>	P									10	10	10	0	0	0	10
14		Harvard Rd						01741	1.80												633	633	633	0	0	0	633
												C	<input checked="" type="checkbox"/>	County							4,056	4,056	4,056	0	0	4,056	4,056
		Reconstruct and widen roadway.										C	<input type="checkbox"/>	STP(U)							0	0	0	0	4,589	4,589	
Construction																											
3		Urban Arterial Preservation Projects							1	03	<input checked="" type="checkbox"/>	S															
		Rehabilitate existing arterials.										C	<input checked="" type="checkbox"/>	CAPP							918	918	918	20	0	898	918
Prelim. Engineering, Construction																											

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Program Item	Project Name Road Names Work Scope Status	From	To	Road #	Proj #	Envir Len(m)	Work Type	Fund O Meth	Fund Sec	Fund Source	Fund			P.E.	R.W.	Const	Total		
											Stat	Fund	Funds						
4	Glennrose Realignment																		
	16	Glennrose Road	37th Avenue	57th Avenue	01537	1.88		P											
	16	57th Avenue	Palouse Hwy	Glennrose Road	06002	0.25		C	<input checked="" type="checkbox"/> County			69	69	0	0	69			
Widen and realign to urban section from Palouse Highway to 37th.																			
Prelim. Engineering																			
5	32nd Avenue Reconstruction Project																		
	16	32nd Avenue	Conklin Road	Barker Road	05972	1.52		P											
								C	<input checked="" type="checkbox"/> County		216	34	0	34	0	34			
Reconstruct and widen to 36 feet from Conklin to Barker Road. Improve intersection at Linke Road.																			
Right-of-Way																			
6	Minor Urban Projects																		
								S											
								C	<input checked="" type="checkbox"/> County		100	10	10	80	100				
Minor improvements at various locations.																			
Prelim. Engineering, Right-of-Way, Construction																			
Urban Construction Projects Total:																			
												4,713	918	10	636	550	280	5,987	9,477

Division of Engineering
Department of Public Works
2012 - 2017 Six Year Transportation Improvement Program
2014 Annual Construction Program

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Dollars in thousands

Program Item	Func Class	Project Name Road Names Work Scope Status	From	To	Road #	Proj #	Envir Len(m)	Fund				Fed Funds	State Funds	Other Funds	County Funds	P.E.	R.W.	Const	Total
								Work C	Work O	Meth	Sec								
Pathway Construction																			
7		Arterial Sidewalks & Pathways					I	06	<input checked="" type="checkbox"/>	S									
		Construct sidewalks along various arterials						C		<input checked="" type="checkbox"/>	County				40	5	0	35	40
		Prelim. Engineering, Construction													5	0	35		40
Pathway Construction Projects Total:															40	5	0	35	40

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Program Item	Func Class	Project Name		Fund		Envir Len(m)	Work Type	C Work O Meth	Fund Sec	Source	Funds	Fed Funds	State Funds	Other Funds	County Funds	P.E.	R.W.	Const	Total
		Road Names	Work Scope	Status	From														

8 Various RID Projects
Various roads

Prelim. Engineering, Construction

1,020	180	400	0	800	1,200
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Hearing Date:	10/25/2011	Adoption Date:	10/25/2011
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Program Item	Func Class	Project Name		Fund		Fed Funds	State Funds	Other Funds	County Funds	P.E.	R.W.	Const	Total
		Road Names	Work Scope	Stat	Fund								
		From	To	Road #	Proj #	Envt Len(m)	Work Type	C Work O Meth	Sec Fund Source				

9 Safety Improvement Projects
Various roads

Prelim. Engineering, Right-of-Way, Construction

150	18	5	5	158	168
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Division of Engineering
Department of Public Works
2012 - 2017 Six Year Transportation Improvement Program
2014 Annual Construction Program

Hearing Date: 10/25/2011 Adoption Date: 10/25/2011
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Dollars in thousands

Program Item	Func Class	Project Name Road Names Work Scope Status	From	To	Road #	Proj #	Envir Len(m)	Work Type	Fund Stat	Fund C	Fund O	Fund Meth	Sec	Fund Source	Fed Funds	State Funds	Other Funds	County Funds	P.E.	R.W.	Const	Total
Bridge Construction																						
10		Rutter Parkway Bridge #2604																				
08		Rutter Parkway			Bridge Crossing at MP 3		04216	0.01	10	<input type="checkbox"/> P												
		Rehabilitate existing bridge.							C	<input checked="" type="checkbox"/> County					400			100	0	0	100	100
									C	<input type="checkbox"/> BR								0	0	0	400	400
															0			0	0	0	500	500
Construction																						
11		Seven Mile Bridge							1	09	<input type="checkbox"/> P											
07		Seven Mile Road	@ Coulee Creek		#1602		04444	0.10		C	<input type="checkbox"/> BR				20			16	4	0	0	20
		Replace existing bridge																16	4	0	0	20
		Prelim. Engineering, Right-of-Way																				
12		Christensen Road Bridge No. 1607							1	03	<input type="checkbox"/> P											
		Replace bridge.								C	<input checked="" type="checkbox"/> County				22			2	1	0	1	2
										C	<input type="checkbox"/> BR							2	0	0	20	22
																		3	0	0	21	24
Prelim. Engineering, Construction																						
13		Idaho Road Bridge #6206							1	03	<input type="checkbox"/> P											
		Idaho Road	Bridge over S. Rock Cre				02002	0.00		C	<input checked="" type="checkbox"/> County				160			40	36	4	0	40
		Replace existing bridge.								C	<input type="checkbox"/> BR							144	16	0	0	160
		Prelim. Engineering, Right-of-Way																180	20	0	0	200

Division of Engineering
Department of Public Works

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2012 - 2017 Six Year Transportation Improvement Program
2014 Annual Construction Program

Dollars in thousands

Program Item	Func Class	Project Name Road Names Work Scope Status	From	To	Road #	Proj #	Envir Len(m)	Work Type	Fund Stat		Fed Funds	State Funds	Other Funds	County Funds	P.E.	R.W.	Const	Total
									C	S								
14	Small Bridge Improvements																	
	Various roads.																	
									C	<input checked="" type="checkbox"/> County				25	5	0	20	25
	Bridge Improvements at various locations.													5	0	20		25
	Prelim. Engineering, Construction																	
	Bridge Construction Projects																	
	Total:										602			167	204	24	541	789

Dollars in thousands

Env. Assess. Date: 10/25/2011 Resolution No.:

Project Name										Fund											
Program		Road Names		Work Scope		Status		Start													
Item	Class	Func	Class	Status	From	To	Road #	Proj #	Envir	Work	C	Meth	Fund	Fed	State	Other	County	P.E.	R.W.	Const	Total
Rural Construction																					
15 Bigelow Gulch/Forker Connector - Project 4																					
07		Bigelow Gulch Road		Old Argonne Road		Forker Road		00263		2889		S		03		P		TGP			
										2.91				C		<input checked="" type="checkbox"/> County		17		17	
														C		<input checked="" type="checkbox"/> STP(R)		12		12	
														C		<input checked="" type="checkbox"/> RAP		240		240	
Reconstruct and widen to a 4-lane road with 8-foot shoulders and a 12 foot median.																					
Prelim. Engineering																					
16 Bigelow Gulch/Forker Connector - Project 2																					
07		Bigelow Gulch Road		Urban Boundary		East Welle Road		00263		2620		S		03		P		PT			
										1.32				C		<input type="checkbox"/> STP(R)		366		69	
														C		<input checked="" type="checkbox"/> STP(R)		221		32	
														C		<input checked="" type="checkbox"/> RAP		106		19	
Reconstruct and widen to four lanes with shoulders.																					
Prelim. Engineering, Right-of-Way																					
17 Bigelow Gulch/Forker Connector - Project 3																					
07		Bigelow Gulch Road		E. Welle Road		Jensen Road		00263		2924		S		03		P		PT			
										1.20				C		<input checked="" type="checkbox"/> County		582		0	
														C		<input type="checkbox"/> Other Fed		3,730		0	
Reconstruct roadway and widen to four lanes with shoulders.																					
Construction																					

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Program Item	Func Class	Project Name Road Names Work Scope Status	From	To	Road #	Proj #	Envir Len(m)	Work Type	Fund C Meth	Fund O Meth	Sec Fund Source	Fed Funds	State Funds	Other Funds	County Funds	P.E.	R.W.	Const	Total
18		Bigelow Gulch / Forker Road Interchange				2989A	S	03	<input type="checkbox"/> P		TCGP								
This project will construct a portion of the Bigelow Gulch project at the existing Forker Intersection. A structure will be constructed for Bigelow traffic to pass over Forker traffic to eliminate left turning traffic on Bigelow Gulch Road. Connections to existing Bigelow Gulch Road west near Evergreen Road and east of Forker will be made to provide a driveable link. Prelim. Engineering, Right-of-Way																			
19		Cheney-Spangle Road Reconstruction Project																	
07		Cheney-Spangle Rd	Wells Road	Bradshaw Road	00578		2.81		<input type="checkbox"/> P										
Reconstruct and widen from Wells Road to Bradshaw Road.																			
									C	<input checked="" type="checkbox"/> County		182			28	0	28	0	28
									C	<input type="checkbox"/> STP(F)					0	0	182	0	182
												0			210	0		0	210
20		Right-of-Way																	
08		Espanola BNSF Rail Crossing	@ BNSF Crossing		01161		0.01		<input type="checkbox"/> P										
Improve rail crossing to provide gates.																			
									C	<input checked="" type="checkbox"/> County		29			4	4	0	0	4
									C	<input type="checkbox"/> STP(S)					29	0	0	0	29
												33			0	0	0	0	33
		Prelim. Engineering																	

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Program Item	Func Class	Status	From	To	Road #	Proj #	Envir Len(m)	Work Type	C Work O Meth	Fund					P.E.	R.W.	Const	Total	
										Fund Stat	Fund	Fed Funds	State Funds	Other Funds					County Funds

Construction	
22	Minor Rural Projects Various roads
	1 03 <input type="checkbox"/> S 0.00

Prelim. Engineering, Right-of-Way, Construction					
Rural Construction Projects	7,076	380	1,082	482	1,052
Total:				6,994	8,538

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Program Item	Func Class	Project Name Road Names Work Scope Status	From	To	Road #	Proj #	Envir Length(mi)	Work Type	Fund Stat	C Work	O Meth	Sec Fund	Source	Fed Funds	State Funds	Other Funds	County Funds	P.E.	R.W.	Const	Total
Urban Construction																					
1		Liberty Lake TIF & LIFT				3130	I	01	<input checked="" type="checkbox"/>	S						210	210	0	0	0	210
This CRP is established to administer Spokane County Engineering's responsibilities associated with terms of the Liberty Lake TIF & LIFT (Spokane County River District Revenue Development Area at Liberty Lake).																					
Prelim. Engineering																					
2		Urban Arterial Preservation Projects					I	03	<input checked="" type="checkbox"/>	S											
Rehabilitate existing arterials.																					
Prelim. Engineering, Construction																					
3		Glenrose Realignment					I	03	<input checked="" type="checkbox"/>	P											
	16	Glenrose Road	37th Avenue	57th Avenue	01537		1.88														
	16	57th Avenue	Palouse Hwy	Glenrose Road	06002		0.25		C	<input checked="" type="checkbox"/>	County			467			73	0	73	0	73
Widen and realign to urban section from Palouse Highway to 37th.																					
Right-of-Way																					
									C	<input type="checkbox"/>	STP(U)						0	0	467	0	467
																	0	540	0		640

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Program Item	Project Name Road Names Work Scope Status	From	To	Road #	Proj #	Envir Len(m)	Work Type	Fund C	Stat O	Fund Meth	Sec	Fund Source	Fed Funds	State Funds	Other Funds	County Funds	P.E.	R.W.	Const	Total
4	32nd Avenue Reconstruction Project																			
16	32nd Avenue	Conklin Road	Barker Road	05972		1.52		<input checked="" type="checkbox"/> P												
	Reconstruct and widen to 36 feet from Conklin to Barker Road. Improve intersection at Linke Road.							C		<input checked="" type="checkbox"/> County			2,197			343	0	0	343	343
								C		<input type="checkbox"/> STP(U)							0	0	2,197	2,197
																	0	0	2,540	2,540
5	Barker Road Reconstruction																			
16	Barker Road	City Limits	32nd Avenue	00230		1.74		<input checked="" type="checkbox"/> P												
	Reconstruct and widen to an urban section. City Limits to 32nd Ave.							C		<input checked="" type="checkbox"/> County			285			45	45	0	0	45
								C		<input type="checkbox"/> STP(U)							285	0	0	285
																	330	0	0	330
6	Prelim. Engineering																			
	Minor Urban Projects							<input checked="" type="checkbox"/> S												
	Minor Improvements at various locations.							C		<input checked="" type="checkbox"/> County						100	10	10	80	100
	Prelim. Engineering, Right-of-Way, Construction																10	10	80	100
	Urban Construction Projects Total:												2,949	918	210	561	570	550	3,518	4,538

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Program Item	Func Class	Project Name Road Names Work Scope Status	From	To	Road #	Proj #	Envir Len(m)	Work Type	C Work O Meth	Fund Sec	Fund Source	Fed Funds	State Funds	Other Funds	County Funds	P.E.	R.W.	Const	Total	
																				Fund Start
Pathway Construction																				
7		Arterial Sidewalks & Pathways					I	06	<input checked="" type="checkbox"/>	S										
		Construct sidewalks along various arterials							C		<input checked="" type="checkbox"/> County				40	5	0	35	40	
		Prelim. Engineering, Construction													5	0	35		40	
Pathway Construction Projects Total:																40	5	0	35	40

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		Project Name			Fund																			
Program	Fund	Road Names	Work Scope	Status	Start	Fund	Fed	State	Other	County	P.E.	R.W.	Const	Total										
Item	Class				From	To	Road #	Proj #	Envir	Work	Type	O	Meth	Sec	Fund Source	Funds	Funds	Funds	Funds					
Road Improvement Districts																								
8	Various RID Projects								1	03	<input checked="" type="checkbox"/>	S												
	Various roads								0.00															
														<input checked="" type="checkbox"/> County										
														<input checked="" type="checkbox"/> RID Bonds										
		Reconstruct gravel roads.																						
		Prelim. Engineering, Construction																						
Road Improvement Districts Projects Total:																1,020	180	400	0	800	1,200			

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Program Item	Fund Class	Project Name Road Names Work Scope Status	From	To	Road #	Proj #	Envt Len(m)	Work Type	C Work O Meth	Fund Sec	Fund				P.E.	R.W.	Const	Total
											Fund Stat	Fed Funds	State Funds	Other Funds				

9 Safety Improvement Projects

1 12 ☐ P

C	<input checked="" type="checkbox"/> County	16	5	5	6	16
C	<input type="checkbox"/> STP(S)	150	0	0	150	150

5	5	156	166
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150	16	5	5	156	166
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Program Item	Func Class	Project Name Road Names Work Scope Status	From	To	Road #	Proj #	Envir Length(mi)	Work Type	Fund Stat	C Work	Fund Meth	Sec Fund Source	Fed Funds	Slate Funds	Other Funds	County Funds	P.E.	R.W.	Const	Total
Bridge Construction																				
10		Idaho Road Bridge #6206 Idaho Road	Bridge over S. Rock Cre		02002		0.00	I	03	<input type="checkbox"/> P										
		Replace existing bridge.							C	<input checked="" type="checkbox"/> County			1,200			300	0	0	300	300
									C	<input type="checkbox"/> BR						0	0	0	1,200	1,200
													0			0	0	1,500	1,500	
Construction																				
11		Small Bridge Improvements Various roads.						I	11	<input type="checkbox"/> S										
		Bridge Improvements at various locations.							C	<input checked="" type="checkbox"/> County						25	5	0	20	25
																5	0	0	20	25
		Prelim. Engineering, Construction																		
Bridge Construction Projects Total:													1,200			325	5	0	1,520	1,525

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Program Item	Func Class	Project Name Road Names Work Scope Status	From	To	Road #	Proj #	Envir Len(mi)	Work Type	Fund C	Work O	Fund Meth	Sec	Fund Source	Fed Funds	State Funds	Other Funds	County Funds	P.E.	R.W.	Const	Total
Rural Construction																					
12		Bigelow Gulch/Forker Connector - Project 4																			
07		Bigelow Gulch Road	Old Argonne Road	Forker Road	00263		2.91	S					TGP	205	1,840			0	180	25	205
									C				STP(R)					0	1,615	225	1,840
									C				RAP					0	1,795	250	2,045
Reconstruct and widen to a 4-lane road with 8-foot shoulders and a 12 foot median.																					
Right-of-Way, Construction																					
13		Bigelow Gulch / Forker Road Interchange																			
						2989A		S					TCGP								
									C				County	22				0	0	22	22
									C				STP(R)	3,260				0	0	3,260	3,260
									C				RAP	426				0	0	426	426
									C				FMSIB	2,269				0	0	2,269	2,269
																		0	0	5,977	5,977
This project will construct a portion of the Bigelow Gulch project at the existing Forker intersection. A structure will be constructed for Bigelow traffic to pass over Forker traffic to eliminate left turning traffic on Bigelow Gulch Road. Connections to existing Bigelow Gulch Road west near Evergreen Road and east of Forker will be made to provide a driveable link.																					
Construction																					
14		Cheney-Spangle Road Reconstruction Project																			
07		Cheney-Spangle Rd	Wells Road	Bradshaw Road	00578		2.81														
									C				County	481				0	0	481	481
									C				STP(R)	3,080				0	0	3,080	3,080
																		0	0	3,561	3,561
Reconstruct and widen from Wells Road to Bradshaw Road.																					
Construction																					

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Program Item	Func Class	Project Name Road Names Work Scope Status	From	To	Road #	Proj #	Envir Len(m)	Work Type	Fund Stat		Fed Funds	State Funds	Other Funds	County Funds	P.E.	R.W.	Const	Total
									C	O								
15		Craig Road Reconstruction Project																
07	Craig Road	SR 902		Thorpe Road	00653		1.33			P								
07	Craig Road	Thorpe Road		US 2	00654		2.00		C	<input checked="" type="checkbox"/> County	450			70	70	0	0	70
									C	<input type="checkbox"/> STP(R)				450	0	0	0	450
											520			520	0	0	0	520
		Reconstruct and widen to 36 feet from SR 902 to SR 2.																
16		Prelim. Engineering																
08	Espanola Road	@ BNSF Crossing			01161		0.01			P								
									C	<input checked="" type="checkbox"/> County	39			0	0	0	39	39
									C	<input type="checkbox"/> STP(S)	253			0	0	253	253	253
		Improve rail crossing to provide gates.									0			0	0	292	292	292
17		Construction																
		Minor Rural Projects								S								
		Various roads					0.00											
		Minor improvements at various locations.							C	<input checked="" type="checkbox"/> County	100			10	10	80	100	100
		Prelim. Engineering, Right-of-Way, Construction									10			10	10	80	100	100
		Rural Construction Projects Total:									9,517	2,266		712	530	1,805	10,160	12,495

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Program Item	Func Class	Project Name Road Names Work Scope Status	From	To	Road #	Proj #	Envir Len(m)	Work Type	C Work O Meth	Fund Sec	Fund Source	Fund Stat					P.E.	R.W.	Const	Total
												Fed Funds	State Funds	Other Funds	County Funds					
Total Program for 2015												13,818	3,184	1,230	1,834	1,515	2,380	18,189	20,084	

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Program Item		Project Name Road Names Work Scope Status			Fund														
Func Class		From	To	Road #	Proj #	Envir Len(m)	Work Type	Fund Stat	Fund C Work	Fund O Meth	Sec Fund Source	Fed Funds	State Funds	Other Funds	County Funds	P.E.	R.W.	Const	Total
Urban Construction																			
1	Glenrose Realignment																		
18	Glenrose Road	37th Avenue	57th Avenue	01537		1.88		03	<input checked="" type="checkbox"/>	P									
18	57th Avenue	Palouse Hwy	Glenrose Road	06002		0.25			C	<input checked="" type="checkbox"/>	County				693	0	0	693	693
									C	<input type="checkbox"/>	STP(U)					0	0	4,437	4,437
	Widen and realign to urban section from Palouse Highway to 37th.																		
	Construction																		
2	Barker Road Reconstruction																		
16	Barker Road	City Limits	32nd Avenue	00230		1.74		03	<input checked="" type="checkbox"/>	P									
									C	<input checked="" type="checkbox"/>	County				44	0	44	0	44
									C	<input type="checkbox"/>	STP(U)					0	281	0	281
	Reconstruct and widen to an urban section. City Limits to 32nd Ave.																		
	Right-of-Way																		
3	Minor Urban Projects																		
								I	06	<input checked="" type="checkbox"/>	S								
									C	<input checked="" type="checkbox"/>	County								
	Minor improvements at various locations.																		
	Prelim. Engineering, Right-of-Way, Construction																		
4	Urban Arterial Preservation Projects																		
								I	03	<input checked="" type="checkbox"/>	S								
									C	<input checked="" type="checkbox"/>	CAPP				918	20	0	898	918
	Rehabilitate existing arterials.																		
	Prelim. Engineering, Construction																		

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							Start	Work C	Fund								
Urban Construction Projects Total:																	
							Envir	Work	Fund								
							Len(m)	Type	Sec	Fund Source							
											Funds	Funds	Funds				
											4,718	918	837	30	335	6,108	6,473

Pathway Construction

5	Arterial Sidewalks & Pathways	I	06	<input checked="" type="checkbox"/> S														
	Construct sidewalks along various arterials			C	<input checked="" type="checkbox"/> County						40	5	0	35	40			
	Prelim. Engineering, Construction										5	0	35	40				
Pathway Construction Projects Total:											40	5	0	35	40			

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					Stat	Fund	Fed Funds	State Funds				
					Envir	Work	C Work	Fund				
					Len(ft)	Type	O Meth	Sec Fund Source	Funds	Funds	Funds	Funds

1,020	180	400	0	800	1,200
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									C	W	Fund								
Traffic Safety Improvements																			
7		Safety Improvement Projects					I	12	<input type="checkbox"/> P										
		Various roads																	
		Minor traffic safety improvements at various locations.							C		<input checked="" type="checkbox"/> County		150		15	5	5	5	15
									C		<input type="checkbox"/> STP(S)					0	0	150	180
																5	5	155	165
		Prelim. Engineering, Right-of-Way, Construction																	
Traffic Safety Improvements Projects Total:												150			15	5	5	155	185

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Program Item	Func Class	Project Name Road Names Work Scope Status	From	To	Road #	Proj #	Envir Len(m)	Work Type	C Work O Meth	Fund Stat				Fed Funds	State Funds	Other Funds	County Funds	P.E.	R.W.	Const	Total		
										Start	Fund	Sec	Fund Source										
Bridge Construction																							
8	Small Bridge Improvements										I	11	<input type="checkbox"/>	S									
	Various roads.																						
	Bridge Improvements at various locations.												C	<input checked="" type="checkbox"/>	County								
	Prelim. Engineering, Construction																						
Bridge Construction Projects										Total:				25	5	0	20	25					

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Program Item	Func Class	From	To	Fund				Fed Funds	State Funds	Other Funds	County Funds	P.E.	R.W.	Const	Total
				Start	Endr	Work C	Fund								
Project Name	Road Names	Work Scope	Status	Road #	Proj #	Len(ft)	Type	O Meth	Sec	Fund Source	Funds	Funds	Funds	Funds	Funds
Rural Construction															

Right-of-Way

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Program Item	Func Class	Project Name Road Names Work Scope Status	From	To	Road #	Proj #	Envir Len(m)	Fund Stat		Fed Funds	State Funds	Other Funds	County Funds	P.E.	R.W.	Const	Total
								Work C	Work O								
12	Minor Rural Projects	Various roads					1	03	<input type="checkbox"/> S								
		Minor Improvements at various locations.					0.00										
		Prelim. Engineering, Right-of-Way, Construction															
		Rural Construction Projects Total:								9,683	3,204	222	435	480	12,184	13,109	
Total Program for 2016										14,551	4,122	1,020	1,319	880	830	19,302	21,012

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Program Item	Funct Class	Project Name Road Names Work Scope Status	From	To	Road #	Proj #	Fund					P.E.	R.W. Const	Total
							Envr/ Work C Work Fund	Fed Funds	State Funds	Other Funds	County Funds			
Urban Construction														

Year	100	10	10	80	100
1990	100	10	10	80	100
1991	100	10	10	80	100
1992	100	10	10	80	100
1993	100	10	10	80	100
1994	100	10	10	80	100
1995	100	10	10	80	100
1996	100	10	10	80	100
1997	100	10	10	80	100
1998	100	10	10	80	100
1999	100	10	10	80	100
2000	100	10	10	80	100
2001	100	10	10	80	100
2002	100	10	10	80	100
2003	100	10	10	80	100
2004	100	10	10	80	100
2005	100	10	10	80	100
2006	100	10	10	80	100
2007	100	10	10	80	100
2008	100	10	10	80	100
2009	100	10	10	80	100
2010	100	10	10	80	100
2011	100	10	10	80	100
2012	100	10	10	80	100
2013	100	10	10	80	100
2014	100	10	10	80	100
2015	100	10	10	80	100
2016	100	10	10	80	100
2017	100	10	10	80	100
2018	100	10	10	80	100
2019	100	10	10	80	100
2020	100	10	10	80	100
2021	100	10	10	80	100
2022	100	10	10	80	100
2023	100	10	10	80	100
2024	100	10	10	80	100
2025	100	10	10	80	100
2026	100	10	10	80	100
2027	100	10	10	80	100
2028	100	10	10	80	100
2029	100	10	10	80	100
2030	100	10	10	80	100
2031	100	10	10	80	100
2032	100	10	10	80	100
2033	100	10	10	80	100
2034	100	10	10	80	100
2035	100	10	10	80	100
2036	100	10	10	80	100
2037	100	10	10	80	100
2038	100	10	10	80	100
2039	100	10	10	80	100
2040	100	10	10	80	100
2041	100	10	10	80	100
2042	100	10	10	80	100
2043	100	10	10	80	100
2044	100	10	10	80	100
2045	100	10	10	80	100
2046	100	10	10	80	100
2047	100	10	10	80	100
2048	100	10	10	80	100
2049	100	10	10	80	100
2050	100	10	10	80	100
2051	100	10	10	80	100
2052	100	10	10	80	100
2053	100	10	10	80	100
2054	100	10	10	80	100
2055	100	10	10	80	100
2056	100	10	10	80	100
2057	100	10	10	80	100
2058					

918	20	0	898	918
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 Env. Assess. Date: 10/25/2011 Resolution No.:

Dollars in thousands

Program Item	Func Class	Project Name Road Names Work Scope Status	From	To	Road #	Proj #	Envir Len(m)	Work Type	Fund C	Fund Stat	Fund D	Fund Source	Fed Funds	State Funds	Other Funds	County Funds	P.E.	R.W.	Const	Total
Urban Construction Projects Total:													2,339	918	9	457	80	20	3,623	3,723

Pathway Construction

5	Arterial Sidewalks & Pathways																			
	Construct sidewalks along various arterials																			
	Prelim. Engineering, Construction																			
Pathway Construction Projects Total:																				

Division of Engineering
Department of Public Works
2012 - 2017 Six Year Transportation Improvement Program
2017 Annual Construction Program

Hearing Date: 10/25/2011 Adoption Date: 10/25/2011
 Env. Assess. Date: 10/25/2011 Resolution No.:

Dollars in thousands

Program Item	Func Class	Project Name Road Names Work Scope Status	From	To	Road #	Proj #	Envir Len(m)	Work Type	Fund C Meth	Fund Sec	Fund Source	Fed Funds	State Funds	Other Funds	County Funds	P.E.	R.W.	Const	Total
Road Improvement Districts																			
6		Various RID Projects					1	03	<input checked="" type="checkbox"/>	S									
		Various roads					0.00												
		Reconstruct gravel roads.							C	<input checked="" type="checkbox"/>	County			1,020	180	60	0	120	180
										<input checked="" type="checkbox"/>	RID Bonds				340	0	680	1,020	
															400	0	800	1,200	
		Prelim. Engineering, Construction																	
Road Improvement Districts Projects Total:													1,020	180	400	0	800	1,200	

Hearing Date:	10/25/2011	Adoption Date:	10/25/2011
Env. Assess. Date:	10/25/2011	Resolution No.:	

[illegible]

7 Safety Improvement Projects

1 12 \square p

C	<input checked="" type="checkbox"/> County	15	5	5	15
C	<input type="checkbox"/> STP(S)	150	0	0	150

Traffic Safety Improvements Projects Total:

150	15	5	5	155	165
-----	----	---	---	-----	-----

Division of Engineering
Department of Public Works
2012 - 2017 Six Year Transportation Improvement Program
2017 Annual Construction Program

Hearing Date: 10/25/2011 Adoption Date: 10/25/2011
 Env. Assess. Date: 10/25/2011 Resolution No.:

Dollars in thousands

Program Item	Func Class	Project Name Road Names Work Scope Status	From	To	Road #	Proj #	Envir Len(m)	Work Type	Fund					Fed Funds	State Funds	Other Funds	County Funds	P.E.	R.W.	Const	Total
									Stat	Fund	Fund	Sec	Source								
Bridge Construction																					
8		Small Bridge Improvements Various roads.					I	11	<input type="checkbox"/>	S											
		Bridge improvements at various locations.							C	<input checked="" type="checkbox"/>	County						25	5	0	20	25
		Prelim. Engineering, Construction																5	0	20	25
Bridge Construction Projects Total:																	25	5	0	20	25

**Division of Engineering
Department of Public Works
2012 - 2017 Six Year Transportation Improvement Program
2017 Annual Construction Program**

Hearing Date: 10/25/2011 Adoption Date: 10/25/2011
Env. Assess. Date: 10/25/2011 Resolution No.:

Dollars in thousands

Program Item	Func Class	Project Name Road Names Work Scope Status	From	To	Road #	Proj #	Envir Len(m)	Work Type	Fund Stat	Fund C Work	Fund O Work	Fund S Source	Fed Funds	State Funds	Other Funds	County Funds	P.E.	R.W.	Const	Total
Rural Construction																				
9		Bigelow Gulch/Forker Connector - Project 5																		
	07	Forker Road	Bigelow Gulch Rd (end)	Progress Road	01349	2990	S	03	<input type="checkbox"/>	P	TGP									
						0.95			C	<input type="checkbox"/>	Other Fed	206	1,838	106	100	0	0	0	206	
									C	<input checked="" type="checkbox"/>	RAP			946	892	0	1,838			
														1,052	992	0	2,044			
Reconstruct and widen to a 4-lane road with 8-foot shoulders and a 12 foot turn-lane where necessary																				
Prelim. Engineering, Right-of-Way																				
10		Craig Road Reconstruction Project																		
	07	Craig Road	SR 902	Thorpe Road	00653	1.33	I	03	<input type="checkbox"/>	P										
	07	Craig Road	Thorpe Road	US 2	00654	2.00			C	<input checked="" type="checkbox"/>	County	3,641	568	0	0	568	568			
									C	<input type="checkbox"/>	STP(R)		0	0	3,641	3,641				
													0	0	4,209	4,209				
Reconstruct and widen to 36 feet from SR 902 to SR 2.																				
Construction																				
11		Waverly Road Reconstruction Project																		
	07	Waverly Road	SR 27	Waverly City Limits	05229	2.29	I	03	<input type="checkbox"/>	P										
									C	<input checked="" type="checkbox"/>	County	125	20	0	20	0	20			
									C	<input type="checkbox"/>	STP(R)		0	125	0	125				
													0	145	0	145				
Realign, widen and reconstruct to 36 feet from Waverly City Limits to SR-27.																				
Right-of-Way																				

**Division of Engineering
Department of Public Works
2012 - 2017 Six Year Transportation Improvement Program
2017 Annual Construction Program**

Hearing Date: 10/25/2011 Adoption Date: 10/25/2011
Env. Assess. Date: 10/25/2011 Resolution No.:

Dollars in thousands

Program Item	Func Class	Project Name Road Names Work Scope Status	From	To	Road #	Proj #	Envir Len(m)	Work Type	Fund C Work O Meth	Fund Sec Fund Source	Fed Funds	State Funds	Other Funds	County Funds	P.E.	R.W.	Const	Total
12	Minor Rural Projects	Various roads					1	03	<input type="checkbox"/> S									
		Minor Improvements at various locations.					0.00		C	<input checked="" type="checkbox"/> County				100	10	10	80	100
		Prelim. Engineering, Right-of-Way, Construction												10	10	80	100	
		Rural Construction Projects Total:									3,972	1,838	688	1,082	1,147	4,289	6,498	
Total Program for 2017											8,481	2,756	1,028	1,405	1,557	1,172	8,922	11,951

**Spokane County
Department of Public Works
Engineering Division
2012 – 2017 Six Year Transportation Improvement Program
2012 Recommended Equipment Purchase List**

EQUIPMENT RENTAL AND REVOLVING FUND
2012 EQUIPMENT PURCHASE LIST

6	Class 8 Dump Trucks with Boxes	\$1,010,000
6	Truck Snow Plows	\$ 40,000
4	V-Box Sanders	\$135,000
2	Compact Extended Cab 4X4 Pickups with Ambulance	\$ 80,000
6	Sedan Passenger Cars	\$120,000
1	Central Shop Roof Repair	<u>\$115,000</u>
TOTAL		\$ 1,500,000

BEFORE THE BOARD OF COUNTY COMMISSIONERS
OF SPOKANE COUNTY, WASHINGTON

IN THE MATTER OF ADOPTING THE 2011-)
2016 SIX-YEAR SEWER CONSTRUCTION) RESOLUTION
CAPITAL IMPROVEMENT PROGRAM)

WHEREAS, pursuant to the provisions of the Revised Code of Washington (RCW), Section 36.32.120(6), the Board of County Commissioners of Spokane County (hereinafter the "Board") has the care of County property and the management of County funds and business; and

WHEREAS, pursuant to the provisions of RCW Chapters 36.70 and 36.94, the Board has adopted a Comprehensive Wastewater Management Plan as an element of the County's Generalized Comprehensive Plan; and

WHEREAS, pursuant to the provisions of the Comprehensive Wastewater Management Plan, Spokane County has the power to construct, operate and maintain a system of sewerage within the unincorporated areas of Spokane County; and

WHEREAS, pursuant to the provisions and priorities of the adopted Comprehensive Wastewater Management Plan, the Department of Public Works, Division of Utilities submitted the attached "2011-2016 Six-Year Sewer Construction Capital Improvement Program" (hereinafter the "CIP"); and

WHEREAS, notice of public hearing was given as required by RCW 36.36.120(7) and 65.16.160; and

WHEREAS, pursuant to Resolution No. 10-0867, the Board cancelled the October 12, 2010 Public Hearing and rescheduled all items originally scheduled for that date (including the hearing for the adoption of the CIP) to 5:30 pm, October 26, 2010; and

WHEREAS, pursuant to the provisions of RCW Section 36.94.080, the Board held a public hearing on October 26, 2010, at 5:30 p.m., in the Assembly Room of the Board to consider "Adopting the 2011-2016 Six-Year Sewer Construction Capital Improvement Program"; and

WHEREAS, after considering all public testimony submitted at the public hearing, the Board concludes that it is in the best interest of the public and the orderly management, regulation and control of the County's sewer construction program to adopt the attached "2011-2016 Six-Year Sewer Construction Capital Improvement Program".

No. 10-0926

NOW, THEREFORE, BE IT HEREBY RESOLVED by the Board of County Commissioners of Spokane County, Washington, that the Board does hereby adopt the attached "2011-2016 Six-Year Sewer Construction Capital Improvement Program".

BE IT FURTHER RESOLVED that the Public Works Department, Division of Utilities is authorized to proceed with the engineering, right-of-way acquisition, and preparation of plans/specifications for construction of the improvements

BE IT FURTHER RESOLVED that a State Environmental Protection Act checklist will be prepared for each sewer project, as applicable.

ADOPTED by the Board of County Commissioners of Spokane County, Washington, this 26th day of October 2010.



ATTEST:

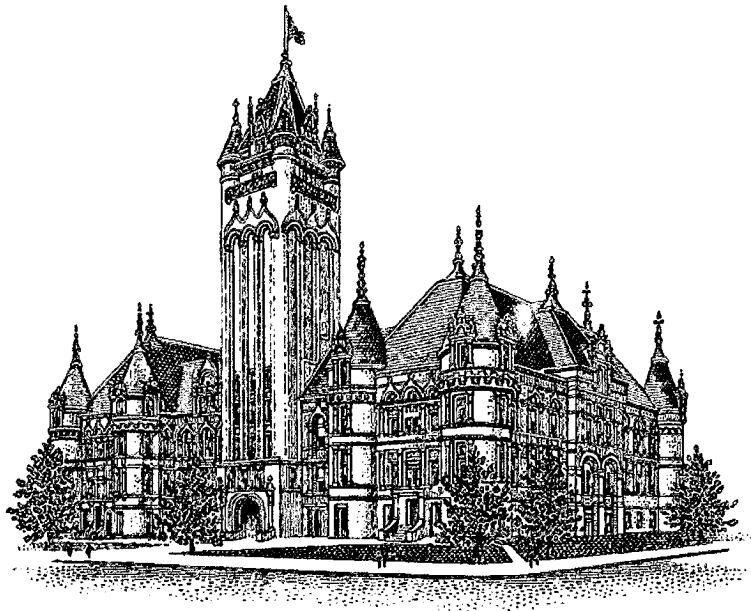
BY: Daniela Erickson
Daniela Erickson, Clerk of the Board
10-0926

Mark Richard
Mark Richard, Chair

Bonnie Mager
Bonnie Mager, Vice-Chair

Todd Mielke
Todd Mielke, Commissioner

10-0926



SPOKANE COUNTY

SIX-YEAR SEWER CONSTRUCTION CAPITAL IMPROVEMENT PROGRAM

2011 Through 2016

October 2010

SPOKANE COUNTY

SIX-YEAR SEWER CONSTRUCTION CAPITAL IMPROVEMENT PROGRAM

2011 Through 2016

Prepared by
Department of Public Works
Division of Utilities
October 2010

Adopted by
Board of County Commissioners
of Spokane County
Resolution No. 10-xxxx

10-0926

**SIX-YEAR
SEWER CONSTRUCTION
CAPITAL IMPROVEMENT PROGRAM
2011 Through 2016**

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Section 1 - Purpose

The purpose of the Six-Year Sewer Construction Capital Improvement Program (the "CIP") is to delineate the County's sewer improvement priorities and associated expenditures and financing for 2011 through 2016; and, provide authorization to proceed with the engineering, right-of-way acquisition and preparation of plans/specifications for construction of the capital improvements.

Section 2 - Sewer Construction Program

The primary purpose of the County's Sewer Construction Program is to expedite the construction of sanitary sewers and dramatically reduce the number of on-site sewage treatment facilities over the Spokane-Rathdrum Aquifer; and, to satisfy regulations established by the State Department of Health, State Department of Ecology, Spokane County Health District and other regulatory agencies. The CIP was developed in accordance with the accelerated schedule for completion of the Septic Tank Elimination Program as detailed in the 2001 Comprehensive Wastewater Management Plan (CWMP), adopted by the Board by Resolution No. 2-0563.

This section of the CIP provides detail regarding the County's Sewer Construction Program for each year 2011 to 2016 (Tables 2-1 through 2-6). The Sewer Construction Program includes three projects that represent the balance of the County's Septic Tank Elimination Program (STEP), scheduled for completion in 2011. The projects are the Mica View, Green Haven and Belle Terre Sewer Projects. The areas affected by these three projects are depicted on the Spokane Valley Sewers map on page 10.

The County's Sewer Construction Program also includes miscellaneous sewer construction projects that are anticipated to be undertaken in conjunction with State, County and City road projects (such as the Farwell Road Sewer Project), as well as sewer trunk extensions (such as the US 2 Trunk Extension).

Tables 2-1 through 2-6 show the projects within each year's Program, total cost estimates for each project and the applicable funding sources for the respective Annual Sewer Construction Program. Table 2-7 summarizes the information presented in Tables 2-1 through 2-6.

A "Program Funding Sources" information block is contained within each of the Sewer Construction Program tables (Tables 2-1 through 2-7) similar to the sample below:

S A M P L E	
Program Funding Sources	
State Grant	\$0
General Facilities Fund	\$0
Capital Facilities Rate Prepayments	\$0
Bonds	\$0
Sewer Construction Fund Reserves	\$0
Total	\$0

Spokane County uses a number of sources to fund its Sewer Construction Program. Each of these funding sources is discussed below:

State Grant: A Centennial Clean Water Fund grant from the Washington State Department of Ecology for \$3,750,000 per year through 2014 for the completion of the Septic Tank Elimination Program (as detailed in the 2001 Comprehensive Wastewater Management Plan).

General Facilities Fund: General Facilities Charges (GFCs) are collected from all customers connecting to the County's System, pursuant to Spokane County Code (SCC) Chapter 8.03. The GFC revenue is deposited into the General Facilities Fund to pay for the major facilities (interceptor, pump stations, treatment plant capacity, etc) required for the System.

Capital Facilities Rate Prepayments: The Capital Facilities Rate (CFR) is the charge for the sewer, proportioned to each property within the Annual Sewer Construction Program, pursuant to SCC Chapter 8.03. The CFR is comprised of a "construction cost component" and the General Facilities Charge (which is deposited into the General Facilities Fund as collected). This funding source identifies the "construction cost component" revenue received from that portion of our customers who elect to prepay their CFR during the prepayment period.

Bonds: The total bond sale needed to support an Annual Sewer Construction Program is determined by calculating the total "construction cost component" of the CFR for the Program minus the CFR Prepayments.

Sewer Construction Fund Reserves: After all applicable State Grant, General Facilities Fund, CFR Prepayments, and Bond funding have been allocated to the Sewer Construction Program, remaining funding requirements are met using reserves in the Sewer Construction Fund. These reserves are comprised of Special Connection Charges and Trunk Charges that have been collected pursuant to the SCC Chapter 8.03, transfers from the Aquifer Protection Area (APA) Fund reserves (APA fees are collected pursuant to SCC Chapter 11.17), residual sales tax revenues deposited in the Sewer Construction Fund in prior years, CFR revenue from projects previously built by

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the County from reserves (i.e. no bonds sold to finance the Program), future extended grant payments for prior eligible expenditures, and interest accrued on Fund balance.

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TABLE 2-1
SPOKANE COUNTY
2011 SEWER CONSTRUCTION PROGRAM *
(Cost Estimate & Funding in Thousands of Dollars)

Program Basins	**No. ERUs	Program Cost Estimate					Program Funding Sources
		Project Mgmt Cost	Design Eng Cost	Const Mgmt Cost	Const Cost	***Total Cost	
Belle Terre, incl DM VI	85	\$65	\$131	\$131	\$2,177	\$2,503	State Grant \$3,750
Green Haven	367	\$158	\$317	\$317	\$5,279	\$6,071	General Facilities Fund \$2,007
Micaview	268	\$88	\$175	\$175	\$2,924	\$3,363	Capital Facilities Rate Prepayments \$435
US 2 Trunk Extension****	N/A	\$26	\$52	\$52	\$868	\$998	Bonds \$2,466
Farwell Road Sewer*****	N/A	\$23	\$45	\$45	\$750	\$863	Sewer Construction Fund Reserves \$5,639
Miscellaneous*****	N/A	\$13	\$26	\$26	\$435	\$500	
Total	720	\$373	\$746	\$746	\$12,433	\$14,298	Total \$14,298

Notes

- * The Sewer Construction Program Year is the calendar year in which construction is planned to begin.
- ** Number of ERUs equals existing ERUs. Growth ERUs are not included.
- *** Total costs for the 2011 STEP Projects are historical trends for the program. Costs for the Green Haven Project include an allowance for a local pump station.
- **** US 2 Truck Extension includes approximately 4,000 LF of sewer adjacent to US Highway 2 in the West 1/2 of Section 9, Township 26 N, Range 43 EWM.
- ***** Miscellaneous includes minor sewer construction in conjunction with Road Projects and maintenance projects. Cost estimates for miscellaneous projects, trunk extensions and the Farwell Road Project are estimated in year of expenditure dollars.

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TABLE 2-2
SPOKANE COUNTY
2012 SEWER CONSTRUCTION PROGRAM *
(Cost Estimate & Funding in Thousands of Dollars)

Program Basins	No. ERUs	Program Cost Estimate						Total Cost	
		Project Mgmt		Design Eng		Const Mgmt			
		Cost		Cost		Cost			
Miscellaneous**	N/A	\$13		\$26		\$26		\$435	\$500
Total	0	\$13		\$26		\$26		\$435	\$500

Program Funding Sources	
Sewer Construction Fund Reserves	\$500
Total	\$500

Program Funding Sources

Sewer Construction Fund Reserves	\$500
Total	\$500

Notes

* The Sewer Construction Program Year is the calendar year in which construction is planned to begin.

** Miscellaneous includes minor sewer construction in conjunction with Road Projects and maintenance projects. Cost estimates for miscellaneous projects are estimated in year of expenditure dollars.

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TABLE 2-3
SPOKANE COUNTY
2013 SEWER CONSTRUCTION PROGRAM *
 (Cost Estimate & Funding in Thousands of Dollars)

		Program Cost Estimate					Program Funding Sources	
Program Basins	No. ERUs	Project Mgmt Cost	Design Eng Cost	Const Mgmt Cost	Const Cost	Total Cost		
Miscellaneous**	N/A	\$13	\$26	\$26	\$435	\$500	Sewer Construction Fund Reserves	\$500
Total	0	\$13	\$26	\$26	\$435	\$500	Total	\$500

Program Funding Sources

Sewer Construction Fund Reserves	\$500
Total	\$500

Notes

* The Sewer Construction Program Year is the calendar year in which construction is planned to begin.

** Miscellaneous includes minor sewer construction in conjunction with Road Projects and maintenance projects. Cost estimates for miscellaneous projects are estimated in year of expenditure dollars.

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TABLE 2-4
SPOKANE COUNTY
2014 SEWER CONSTRUCTION PROGRAM *
 (Cost Estimate & Funding in Thousands of Dollars)

		Program Cost Estimate					Program Funding Sources
	No.	Project		Const		Total	
Program Basins	ERUs	Mgmt Cost	Design Eng Cost	Mgmt Cost	Const Cost	Cost	
Miscellaneous**	N/A	\$13	\$26	\$26	\$435	\$500	
Total	0	\$13	\$26	\$26	\$435	\$500	

Program Funding Sources	
Sewer Construction Fund Reserves	\$500
Total	\$500

Notes

* The Sewer Construction Program Year is the calendar year in which construction is planned to begin.

** Miscellaneous includes minor sewer construction in conjunction with Road Projects and maintenance projects. Cost estimates for miscellaneous projects are estimated in year of expenditure dollars.

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TABLE 2-5
SPOKANE COUNTY
2015 SEWER CONSTRUCTION PROGRAM *
 (Cost Estimate & Funding in Thousands of Dollars)

Program Basins	No. ERUs	Program Cost Estimate						Program Funding Sources	
		Project Mgmt Cost	Design		Const		Total Cost		
			Eng Cost	Cost	Mgmt Cost	Cost			
Miscellaneous**	N/A	\$13	\$26	\$26	\$26	\$435	\$500	Sewer Construction Fund Reserves	\$500
Total	0	\$13	\$26	\$26	\$26	\$435	\$500	Total	\$500

Program Funding Sources

Sewer Construction Fund Reserves	\$500
Total	\$500

Notes

* The Sewer Construction Program Year is the calendar year in which construction is planned to begin.

** Miscellaneous includes minor sewer construction in conjunction with Road Projects and maintenance projects. Cost estimates for miscellaneous projects are estimated in year of expenditure dollars.

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TABLE 2-6									
SPOKANE COUNTY									
2016 SEWER CONSTRUCTION PROGRAM *									
(Cost Estimate & Funding in Thousands of Dollars)									
		Program Cost Estimate							
Program Basins	No. ERUs	Project Mgmt Cost	Design Eng Cost	Const Mgmt Cost	Const Cost	Total Cost			
Miscellaneous**	0	\$13	\$26	\$26	\$435	\$500			
Total	0	\$13	\$26	\$26	\$435	\$500			
		Program Funding Sources							
		Sewer Construction Fund Reserves				\$500			
		Total				\$500			

Notes

* The Sewer Construction Program Year is the calendar year in which construction is planned to begin.

** Miscellaneous includes minor sewer construction in conjunction with Road Projects and maintenance projects. Cost estimates for miscellaneous projects are estimated in year of expenditure dollars.

Legend

UGA Boundary

City of Spokane/
Spokane County Service
Boundary

Sewered Projects (Through 2010)	Septic Tank Elimination Program (2011)

Note: All Above Information Applies to North CIP Map

Note: Project Boundaries Are Approximate And May Change With Further Engineering

September, 2010

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TABLE 2-7
SPOKANE COUNTY
6-YEAR SEWER CONSTRUCTION COST & FINANCING SUMMARY
 (Cost Estimate & Funding in Thousands of Dollars)

*Year	**No. ERUs	Program Cost Estimates				Program Funding Sources					Total Funding	Balance
		Project Mgmt Cost	Design Eng Cost	Const Mgmt Cost	Const Cost	Total Cost	State Grant	General Facilities Fund	CFR Prepay- ments	Bonds	Subsidy Funding from Reserves	
2011	720	\$373	\$746	\$746	\$12,433	\$14,298	\$3,750	\$2,007	\$435	\$2,466	\$5,639	\$14,298
2012	0	\$13	\$26	\$26	\$435	\$500	\$0	\$0	\$0	\$0	\$500	\$0
2013	0	\$13	\$26	\$26	\$435	\$500	\$0	\$0	\$0	\$0	\$500	\$0
2014	0	\$13	\$26	\$26	\$435	\$500	\$0	\$0	\$0	\$0	\$500	\$0
2015	0	\$13	\$26	\$26	\$435	\$500	\$0	\$0	\$0	\$0	\$500	\$0
2016	0	\$26	\$26	\$435	\$500	\$500	\$0	\$0	\$0	\$0	\$500	\$0
Total	720	\$452	\$876	\$1,285	\$14,672	\$16,798	\$3,750	\$2,007	\$435	\$2,466	\$8,139	\$16,798

Notes

* The Sewer Construction Program Year is the calendar year in which construction is planned to begin.

** Number of ERUs equals existing ERUs. Growth ERUs are not included.

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Section 3 - Riverside Park Water Reclamation Facility (RPWRF) Upgrades

Spokane County currently has 10 million gallons per day (mgd) of treatment capacity at the City of Spokane's RPWRF. Significant upgrades are ongoing at the RPWRF in order to meet more stringent discharge requirements imposed by regulation. Spokane County participates in the cost of these upgrades on a "prorated share" basis.

Table 3-1 provides a summary of the County's share of the upgrade costs for the RPWRF for the years 2011 through 2016.

The County's monthly sewer service fees include a Wastewater Treatment Plant Charge (in accordance with SCC Chapter 8.03). These charges are deposited into the County's Wastewater Treatment Plant Fund (WTPF). In turn, a portion of these funds are used to pay the County's share of the RPWRF upgrade costs, either through direct lump sum payment, or through payment of the debt service for bonds sold.

Bonds were sold in 2007 (\$8.29 million) to pay for the County's share of the upgrades completed in 2007. Payments for upgrades completed in 2008 and 2009 have been paid directly from the WTPF fund balance. It is anticipated that payments for upgrades completed in 2010 and 2011 will also be paid directly from the available fund balance, and that additional bonds may be sold in the future to pay for the RPWRF upgrades from 2012 forward.

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TABLE 3-1 SPOKANE COUNTY RIVERSIDE PARK WATER RECLAMATION FACILITY (RPWRF) UPGRADES (Cost Estimate & Funding in Thousands of Dollars)							
Cost Element	2011	2012	2013	2014	2015	2016	Total
Upgrade Costs at RPWRF for Water Quality	\$4,584	\$5,875	\$13,674	\$15,513	\$4,294	\$3,488	\$47,428
Generalized Financing Plan	2011	2012	2013	2014	2015	2016	
Annual Bond Sale Amount	\$0	\$0	\$5,875	\$13,674	\$15,513	\$4,294	
Cumulative Bonds Sold	\$8,290	\$8,290	\$14,165	\$27,839	\$43,352	\$47,646	
Annual Debt Service	\$640	\$640	\$640	\$1,111	\$2,208	\$3,452	
Payments for Upgrades Directly from WTPF Reserves	\$3,100	\$4,584	\$0	\$0	\$0	\$0	
Total for RPWRF from WTPF	\$3,740	\$5,224	\$640	\$1,111	\$2,208	\$3,452	
Notes: -- The 2011-2016 upgrade costs estimates were provided by the City of Spokane, Wastewater Management. -- The 2011 Payment for Upgrades Directly from WTPF Reserves is based on recently updated estimate of County share for 2010. -- The County anticipates selling Limited Tax General Obligation (LTGO) Bonds or Sewer Revenue Bonds to cover a portion of these costs. -- Actual bond sale proceeds in 2007 were \$8.29 million. Next bond sale is anticipated in 2013 for 2012 costs, estimated at \$5.875 million. Each annual bond sale is based on County's share in previous year. -- Funds to pay debt service for the RPWRF Upgrades will come from the Wastewater Treatment Plant Fund. "Annual Debt Service" for each bond sale is assumed to commence in the year following that bond sale. Debt service is calculated using a 20-year repayment period and an assumed interest rate of 5.0%.							

Section 4 - Pump Station and Force Main Projects

This section of the CIP details pump station and force main projects needed to improve the reliability of existing County facilities and/or increase capacity. Table 4-1 provides a summary of the estimated costs and funding for these projects.

The projects for improved reliability (e.g., emergency storage, pump station security improvements and mobile generator) of the sewer system will be funded from the Sewer Operations Fund. The revenue source for this Fund is the monthly sewer service fees collected in accordance with SCC Chapter 8.03.

The projects undertaken to provide additional hydraulic capacity (e.g., pump station expansions and secondary force main construction) will be funded from the General Facilities Fund (as described in Section 2 hereinabove).

TABLE 4-1 SPOKANE COUNTY PUMP STATION & FORCE MAIN PROJECTS (Cost Estimate & Funding in Thousands of Dollars)							
Cost Element	2011	2012	2013	2014	2015	2016	Total
<u>Pasadena Park Pump Station – Emergency Storage</u>							
Project Mgmt/Administration	\$10	\$0	\$0	\$0	\$0	\$0	\$10
Consultant Services	\$40	\$0	\$0	\$0	\$0	\$0	\$40
Construction	\$230	\$0	\$0	\$0	\$0	\$0	\$230
<u>Sun Acres Pump Station</u>							
Project Mgmt/Administration	\$25	\$0	\$0	\$0	\$0	\$0	\$25
Consultant Services	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Construction	\$100	\$0	\$0	\$0	\$0	\$0	\$100
<u>Parallel Interceptor – NSI to RPWRF</u>							
Project Mgmt/Administration	\$40	\$40	\$0	\$0	\$0	\$0	\$80
Consultant Services	\$200	\$200	\$0	\$0	\$0	\$0	\$400
Construction	\$0	\$2,000	\$0	\$0	\$0	\$0	\$2,000
<u>Fairwood Pump Station – Emergency Storage</u>							
Project Mgmt/Administration	\$0	\$10	\$0	\$0	\$0	\$0	\$10
Consultant Services	\$0	\$30	\$0	\$0	\$0	\$0	\$30
Construction	\$0	\$200	\$0	\$0	\$0	\$0	\$200

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TABLE 4-1 (Continued)
SPOKANE COUNTY
PUMP STATION & FORCE MAIN PROJECTS
 (Cost Estimate & Funding in Thousands of Dollars)

Cost Element	2011	2012	2013	2014	2015	2016	Total
<u>Marion Hay Secondary Force Main</u>							
Project Mgmt/Administration	\$0	\$0	\$0	\$50	\$50	\$0	\$100
Consultant Services	\$0	\$0	\$0	\$400	\$200	\$0	\$600
Construction	\$0	\$0	\$0	\$3,000	\$0	\$0	\$3,000
<u>Miscellaneous Pump Station Security / Reliability Improvements</u>							
Project Mgmt/Administration	\$5	\$5	\$5	\$5	\$5	\$5	\$30
Consultant Services	\$15	\$15	\$15	\$15	\$15	\$15	\$90
Construction	\$80	\$80	\$80	\$80	\$80	\$80	\$480
Total	\$745	\$2,580	\$100	\$3,550	\$350	\$100	\$7,425
Funding Sources	2011	2012	2013	2014	2015	2016	Total
Sewer Operations Fund	\$380	\$340	\$100	\$100	\$100	\$100	\$1,120
General Facilities Fund	\$365	\$2,240	\$0	\$3,450	\$250	\$0	\$6,305
Total	\$745	\$2,580	\$100	\$3,550	\$350	\$100	\$7,425

Section 5 - Water Reclamation Program

Facilities

In 2002, Spokane County completed and adopted a Wastewater Facilities Plan that provides an evaluation of long term wastewater treatment capacity needs. The Plan identifies alternatives for near-term (20-years) and long-term (50-years) wastewater treatment alternatives. The Plan was updated in 2006 and 2007 and was approved by the Department of Ecology in 2008. The Plan was again updated in 2010 and is awaiting final approval from Ecology. This Plan is in its implementation phase.

Based on current flow patterns and projections, it is anticipated that the County will reach its 10 million gallons per day (mgd) limit at the City of Spokane Riverside Park Water Reclamation Facility (RPWRF) in approximately 2014, and therefore will need to have the new Spokane County Regional Water Reclamation Facility (SCRWRF) on line before that date.

Since 2003, the County has been in an extensive collaborative process with the Washington State Department of Ecology ("Ecology") regarding water quality requirements in the Spokane River specifically related to the Dissolved Oxygen Total Maximum Daily Load (TMDL). The TMDL was approved by the Environmental Protection Agency on May 20, 2010. The TMDL document will allow the new regional SCRWRF to discharge to the Spokane River. Other alternatives are being pursued for discharge to locations other than the River.

Initially, the SCRWRF will be constructed to a capacity of 8 mgd. It is projected that this capacity will last until approximately 2030. The new SCRWRF is being planned for expansion increments of 4 mgd, and will be expandable up to approximately 24 mgd. It is anticipated that the SCRWRF can handle up to 50-years of future growth.

The SCRWRF and associated facilities is being financed by a Washington State Revolving Fund Loan, revenue bonds and limited tax general obligation bonds. A grant and loan from the Public Works Trust Fund have also been obtained. It is anticipated that debt service will be drawn from the Wastewater Treatment Plant Fund and General Facilities Fund. A new financial plan and wastewater rates analysis was completed in mid-2009 and updated in mid-2010.

The cost estimates for the facilities presented in Table 5-1 are based on the following assumptions:

- New 8 mgd SCRWRF on the Stockyards site, with flows starting in 2012.
- Chemically-Enhanced Primary Treatment, Membrane Bioreactor Treatment, and effluent filtration will meet the requirements of the dissolved oxygen TMDL.
- Outfall to the Spokane River at Havana Street from the SCRWRF site.
- Pump station and force mains from North Valley Interceptor to SCRWRF.
- Pump station and force mains from Spokane Valley Interceptor to SCRWRF.

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- Design/Bid/Build (DBB) public works contracts for the conveyance and reuse projects.
- Design/Build/Operate (DBO) contract for the SCRWRF.
- Agreement with the City of Spokane to land apply biosolids from SCRWRF.
- Purchasing approximately 500 acres (Saltese Flats area) for wetland restoration and enhancement, together with finalizing a feasibility study for the project regarding use of natural runoff and reclaimed water.
- Construction of Phase I facilities at Saltese Flats, using natural runoff.

TMDL Compliance

The TMDL document identifies a number of requirements that will need to be funded by Spokane County, as described below.

One activity calls for implementation of an in-home water conservation program. In 2009, the County began a program to spend up to four years providing supplemental funding for water conservation fixtures in the homes of wastewater customers. The program includes toilets, shower heads and rebates on low-flow clothes washing machines. The conservation program is being funded from the Sewer Operations Fund. The revenue source for this Fund is the monthly sewer service fees collected in accordance with Spokane County Code Chapter 8.03.

The TMDL document requires municipal wastewater agencies that discharge into the Spokane River to produce Class A effluent that is suitable for reclamation; and, to evaluate the feasibility of implementing effluent reuse opportunities, such as urban irrigation, industrial reuse, aquifer recharge, and wetlands restoration. Spokane County's new Regional Water Reclamation Facility will produce Class A effluent. Feasibility studies to identify and evaluate water reclamation opportunities are underway and will be completed in the short term. For this CIP, it has been assumed that reuse projects including Saltese Flats Phase I wetlands restoration, totaling approximately 42 million dollars, will be authorized and funded. This assumption will need to be validated in 2011 and beyond. It is anticipated that these projects will be funded from the Regional Water Reclamation Facilities Fund.

In order for the Spokane River to meet state water quality standards, it is anticipated that reduction of Non-Point Sources (NPS) of phosphorus into the river will need to occur. One element of the TMDL document calls for collaborative funding of a NPS reduction program. It is anticipated that a share of the funding will be provided by the County. The County's share and the funding source for the program have not yet been established. However, it is anticipated that a regional revenue source will be developed on a watershed basis. The County will continue to perform Phase 2 and 3 work on the NPS Phosphorus Study that was initiated in 2007. These phases of the Study are funded by a grant from the Washington State Department of Ecology.

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TABLE 5-1
SPOKANE COUNTY
WATER RECLAMATION PROGRAM
 (Cost Estimate & Funding in Thousands of Dollars)

Cost Elements	2011	2012	2013	2014	2015	2016	Totals
<u>Facilities</u>							
<u>Water Reclamation Facility</u>							
Project Management/Administration	\$420	\$380	\$0	\$0	\$0	\$0	\$800
Public Outreach/Information	\$20	\$20	\$0	\$0	\$0	\$0	\$40
Land/Easements	\$75	\$0	\$0	\$0	\$0	\$0	\$75
Legal	\$20	\$10	\$0	\$0	\$0	\$0	\$30
NPDES Permitting	\$80	\$80	\$0	\$0	\$0	\$0	\$160
Biosolids Implementation	\$100	\$50	\$0	\$0	\$0	\$0	\$150
Biosolids Disposal Equipment	\$400	\$250	\$0	\$0	\$0	\$0	\$650
DBO Construction Management/Inspection	\$1,000	\$400	\$0	\$0	\$0	\$0	\$1,400
DBO Construction	\$28,000	\$7,000	\$0	\$0	\$0	\$0	\$35,000
Water Resource Center	\$200	\$100	\$0	\$0	\$0	\$0	\$300
<u>Influent, Pump Stations & Outfall</u>							
Project Management/Administration	\$65	\$0	\$0	\$0	\$0	\$0	\$65
Legal	\$25	\$0	\$0	\$0	\$0	\$0	\$25
Construction Management/Inspection	\$400	\$0	\$0	\$0	\$0	\$0	\$400
Construction	\$1,700	\$0	\$0	\$0	\$0	\$0	\$1,700
<u>Wetlands Restoration (Saltese Flats Phase 1)</u>							
Project Management/Administration	\$50	\$50	\$50	\$0	\$0	\$0	\$150
Land/Easements	\$600	\$0	\$0	\$0	\$0	\$0	\$600
Legal	\$25	\$25	\$25	\$0	\$0	\$0	\$75
Consultant Services	\$600	\$250	\$50	\$0	\$0	\$0	\$900
Construction	\$0	\$1,000	\$1,000	\$0	\$0	\$0	\$2,000
Subtotal	\$33,780	\$9,615	\$1,125	\$0	\$0	\$0	\$44,520
<u>TMDL Compliance Programs/Projects</u>							
<u>Water Conservation</u>							
Project Management/Administration	\$43	\$44	\$0	\$0	\$0	\$0	\$87
Implementation	\$1,000	\$1,000	\$0	\$0	\$0	\$0	\$2,000
<u>Water Reuse/Recharge Projects *</u>							
Project Management/Administration	\$31	\$32	\$33	\$34	\$0	\$0	\$130
Public Outreach/Information	\$15	\$20	\$15	\$20	\$0	\$0	\$70
Legal	\$25	\$25	\$25	\$25	\$0	\$0	\$100
Consultant Services	\$700	\$500	\$500	\$500	\$0	\$0	\$2,200
Construction	\$500	\$3,000	\$3,000	\$3,000	\$0	\$0	\$9,500
<u>Saltese Flats *</u>							
Project Management/Administration	\$80	\$90	\$100	\$0	\$0	\$0	\$270
Land/Easements	\$0	\$150	\$150	\$0	\$0	\$0	\$300
Legal	\$10	\$5	\$5	\$0	\$0	\$0	\$20
Consultant Services	\$600	\$700	\$800	\$0	\$0	\$0	\$2,100
Construction	\$6,000	\$9,000	\$9,000	\$0	\$0	\$0	\$24,000
<u>Non-Point Source Study</u>							
Project Management/Administration	\$50	\$0	\$0	\$0	\$0	\$0	\$50
Consultant Services	\$200	\$0	\$0	\$0	\$0	\$0	\$200
<u>Implementation</u>							
Project Management/Administration	\$10	\$10	\$11	\$0	\$0	\$0	\$31
Research	\$10	\$10	\$10	\$0	\$0	\$0	\$30
Legal	\$250	\$100	\$5	\$0	\$0	\$0	\$355
Consultant Services	\$100	\$50	\$50	\$0	\$0	\$0	\$200
Subtotal	\$9,624	\$14,736	\$13,704	\$3,579	\$0	\$0	\$41,643
Total	\$43,404	\$24,351	\$14,829	\$3,579	\$0	\$0	\$86,163

TABLE 5-1 (Continued)
SPOKANE COUNTY
WATER RECLAMATION PROGRAM
 (Cost Estimate & Funding in Thousands of Dollars)

Funding Sources	2011	2012	2013	2014	2015	2016	Total
Sewer Operations Fund	\$8,129	\$298	\$1,201	\$0	\$0	\$0	\$9,628
General Facilities Fund	\$500	\$150	\$150	\$0	\$0	\$0	\$800
Wastewater Treatment Plant Fund	\$725	\$525	\$525	\$525	\$0	\$0	\$2,300
Regional Water Reclamation Facilities Fund	\$32,875	\$8,460	\$0	\$0	\$0	\$0	\$41,335
Grants **							
WA State Department of Ecology Grant	\$250	\$0	\$0	\$0	\$0	\$0	\$250
WA State Public Works Trust Fund Grant	\$925	\$925	\$0	\$0	\$0	\$0	\$1,850
Bonds and/or Interim Financing	\$0	\$13,993	\$12,953	\$3,054	\$0	\$0	\$30,000
Total	\$43,404	\$24,351	\$14,829	\$3,579	\$0	\$0	\$86,163

Annual Debt Service Summary ***	2011	2012	2013	2014	2015	2016
WA State Revolving Fund Loan (\$8.5 M)	\$508	\$508	\$508	\$508	\$508	\$508
WA State Public Works Trust Fund Loan (\$1 M)	\$10	\$10	\$10	\$10	\$10	\$10
2008 LTGO Bonds (\$4.9 M)	\$383	\$382	\$386	\$384	\$387	\$384
2009 Wastewater Sys Revenue Bonds (\$29.5 M)	\$1,336	\$1,336	\$1,336	\$1,336	\$1,336	\$6,763
2009 Wastewater Sys Taxable Rev Bonds (\$80.7 M)	\$4,991	\$4,991	\$4,991	\$4,991	\$4,991	\$4,991
2009 Build America Bond Rebates (\$28.4 M)	(\$873)	(\$873)	(\$873)	(\$873)	(\$873)	(\$873)
2010 LTGO Tax Exempt Bonds (25.4 M)	\$1,313	\$1,053	\$3,183	\$3,184	\$3,182	\$3,181
2010 LTGO Taxable Build America Bonds (36.5 M)	\$2,200	\$1,764	\$1,764	\$1,764	\$1,764	\$1,764
2010 Build America Bond Rebates (\$11.2 M)	(\$770)	(\$618)	(\$618)	(\$618)	(\$618)	(\$618)
Bonds and/or Interim Financing (39.6 M)	\$0	\$0	\$1,171	\$2,255	\$2,510	\$2,510
Total Annual Debt Service	\$9,098	\$8,553	\$11,858	\$12,941	\$13,197	\$18,620

Notes:

* Planning for these projects underway. Implementation/construction subject to future direction from the Board of County Commissioners.

**** Grants:**

- Washington State Department of Ecology grant to complete a Non-Point Source Phosphorus Study.
- Washington State Public Works Trust Fund interest rate buy-down grant to assist with SCRWRP construction finance costs.

***** Debt service calculations are based on the following assumptions:**

- Washington State Revolving Fund Loan of \$8.5 million at 1.5% interest, with 20-year repayment schedule beginning in 2009.
- Washington State Public Works Trust Fund Loan for the design of the Influent, Pump Stations and Outfall; \$1 million at 0.5% interest with 20-year repayment schedule beginning in 2010.
- 2008 Limited Tax General Obligation (LTGO) Bonds in the amount of \$4.9 million at 3% to 4.5% variable interest, with 20-year repayment schedule beginning in 2009.
- 2009 Wastewater System Taxable Revenue Bonds in the amount of \$80.7 million at 5.5% to 6.5% variable interest, with 20-year repayment schedule beginning in 2009.
- 2009 Build America Bond Rebates from the Wastewater System Taxable Revenue Bonds. Rebates total \$28.4 million over the 20-year term of the bonds.
- 2010 Limited Tax General Obligation (LTGO) Bonds in the amount of \$61.9 million at 3.0% to 5.01% variable interest, with 20-year repayment schedule beginning in 2011.
- 2010 Build America Bond Rebates from the Wastewater System Taxable Revenue Bonds. Rebates total \$11.2 million over the 20-year term of the bonds.
- Bonds and/or interim financing for 2012 through 2014 expenses, totaling \$30.0 million. Estimated at 5.5% interest and 20-year repayment schedule. Repayment to begin the year following each bond sale.
- The sources of funding for debt service are the General Facilities and Wastewater Treatment Plant Funds.

AGENDA SHEET

SUBMITTING DEPARTMENT: Division of Utilities

CONTACT PERSON: Dave Moss or Kevin Cooke

PHONE NUMBER: 477-7268 or 477-7286

CHECK TYPE OF MEETING ITEM BELOW:

2:00 PM CONSENT AGENDA: ☐
BY LEAVE: ☐

5:00 PM LEGISLATIVE SESSION: ☒
BY LEAVE: ☐

SPECIAL SESSION: ☐

BELOW FOR CLERK'S USE ONLY:

Clerk's Resolution No. 10-0926
Approved: Majority/Unanimous _____
Denied: Majority/Unanimous _____
Renews/Amends No. _____
Public Works No. 6-Year
Purchasing Dept. No. _____


AGENDA TITLE: Public Hearing - In the Matter of Adopting the 2011-2016 Six-Year Sewer Construction Capital Improvement Program

BACKGROUND: The attached proposed 2011-2016 Six-Year Sewer Construction Capital Improvement Program ("CIP") details the County's sewer improvement priorities and the associated expenditures and revenue. The CIP was developed in accordance with the accelerated schedule for the completion of the Septic Tank Elimination Program as detailed in the County's Comprehensive Wastewater Management Plan. The CIP details 9 projects, including the Riverside Park Water Reclamation Facility (RPWRF) Upgrades; Pump Station and Force Main Projects; and, the Water Reclamation Program (new regional facilities and TMDL compliance).

RECOMMENDATION: Adopt the attached 2011-2016 Six-Year Sewer Construction CIP.

FISCAL IMPACT: Budgeted Sewer Construction Fund, Sewer Operation/Maintenance Fund and Spokane Regional Water Reclamation Facilities Fund projects.

SIGNATURES:



Department Head/Elected Official or
Designated Authority (Requesting Agenda Item)

Marshall Farnell
Chief Executive Officer

DISTRIBUTION AFTER COMMISSIONER ACTION: Utilities

☐ Check here if this item needs to be codified in the County Code Book.



STATE OF WASHINGTON
DEPARTMENT OF COMMUNITY,
TRADE AND ECONOMIC DEVELOPMENT

Washington State

Greenhouse Gas Inventory and Reference Case Projections, 1990-2020

December 2007



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Executive Summary

Washington's anthropogenic GHG emissions and sinks (carbon storage) are estimated for the period from 1990 to 2020.¹ Historical GHG emission estimates (1990 through 2005, or most recent historical year) are developed using a set of generally-accepted principles and guidelines for state GHG emission estimates, with adjustments for Washington-specific data and context, as appropriate. The initial reference case emission projection (2006-2020) is based on a compilation of various existing projections of electricity generation, fuel use, and other GHG-emitting activities, along with a set of transparent assumptions.

Relying on the State projections of population and employment growth, utilities' projections of electricity use, and input from Washington staff from CTED, Ecology and other departments, a simple reference case projection was developed for GHG emissions through 2020.

The reference case projection, by design, does not account for the significant policy actions required by Governor Gregoire's Washington Climate Change Challenge (Executive Order 07-02) or any of the recommendations from Washington's Climate Advisory Team (CAT). Therefore, the Reference Case projections in this report should be viewed as a "no recent policy" baseline, against which the benefits of policies, both those recently enacted and those to be recommended by the Climate Advisory Team (CAT), can be assessed.

Washington's Historical and Projected GHG Emissions

Overview

Table ES-1 provides a summary of historical (1990, 2000 and 2005) and projected (2010 and 2020) GHG emissions for Washington. Activities in Washington accounted for about 95 million metric tons (MMt) of *gross* carbon dioxide equivalent² (CO₂e) emissions in 2005. This is equal to about 1% of the total U.S. gross GHG emissions.³ This table also shows if gross emissions are adjusted for estimated forestry and agriculture sequestration, the *net* emissions result may be considerably lower (perhaps as low as 65 MMtCO₂e in 2005). As discussed in Appendix H, the GHG emission estimates for forestry sinks are subject to a significant degree of uncertainty.

¹ The Center for Climate Strategies (CCS) prepared this report in collaboration with the Washington State Department of Ecology (Ecology) and the Washington Department of Community, Trade and Economic Development (CTED) for the Washington Climate Advisory Team (CAT). It relies heavily on past and ongoing emissions inventory work by CTED and Ecology. It contains some updates and adjustments to the figures presented in CTED's 2006 report, *Washington's Greenhouse Gas Emissions: Sources and Trends* (2006), as well as an emissions projection for the purposes of guiding the CAT process.

² This analysis includes the six gases included in the U.S. Greenhouse Gas Inventory: carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF₆). Emissions of these GHGs are presented using a common metric, CO₂ equivalence (CO₂e), which indicates the relative contribution of each gas to global average radiative forcing on a Global Warming Potential (GWP) weighted basis. In order to be consistent with the US EPA National GHG inventory, the GWP values in this report are from the Second Assessment Report (SAR) of the Intergovernmental Panel on Climate Change (IPCC).

³ Gross U.S. emissions in 2005 were 7,260 MMtCO₂e (U.S. EPA, *U.S. Inventory of Greenhouse Gas Emissions and Sinks 1990-2005*).

Figure ES-1 shows the State's emissions per capita and per unit of economic output. On a per capita basis, Washington residents emit about 15 metric tons (Mt) of CO₂e annually. This is much lower than the national average of 25 MtCO₂e/yr. This is because of the state's abundance of hydroelectricity. Per capita emissions in Washington have varied between 15 and 18 MtCO₂e since 1990, largely in the electric and industrial sectors. On the other hand, economic growth exceeded emissions growth throughout the 1990-2005 period (leading to declining GHG emissions per unit of state product). The trends in Washington's emissions per gross state product parallel those for the nation on average, in this time period.

As illustrated in Table ES-1 and figure ES-2, Washington's total GHG emissions have varied significantly between 1990 and 2005, with a general increase from 1990 to 2000 being followed by significant decreases in 2001 and 2002 then increases starting again in 2003 through 2005. The strong decreases reflect energy price swings and resulting impacts on the manufacturing sector in 2001 and 2002. Under the reference case projections, Washington's gross GHG emissions continue the growth of the last few years and are projected to climb to 122 MMtCO₂e per year by 2020, about 38% above 1990 levels.

The principal source of Washington's GHG emissions is transportation, accounting for 47% of total State gross GHG emissions in 2005. The next largest contributors to total gross GHG emissions are fossil fuel combustion in the residential, commercial, and industrial sectors (20%) and electricity consumption from these sectors (20%).

Electricity Consumption

As shown in Table ES-1, Washington's electricity emissions increased strongly between 1990 and 2000, followed by a decrease from 2000 levels by 2005. Much of the year to year variation is due to changes in hydro-electric generation, based on variation in local and regional water levels. Although the reference case includes projections for new wind plants, it also includes growth in generation from natural gas facilities. Overall emissions from electricity consumption are projected to grow by about 6 MMtCO₂e between 2005 and 2020.

Consumption-based Approach vs. Production-based Approach

It is important to note that Table ES-1 shows Washington electricity emissions on a consumption-based (or "load-based") approach, i.e. based on the emissions of electricity sources delivered to Washington consumers, regardless of where those electricity generation facilities are located.

Another way to present electricity emissions is on a production-basis, i.e. the emissions associated with generating facilities located in the state of Washington, regardless of where this electricity is delivered.

Both approaches have been used for state-level GHG emissions analysis, and both are relevant depending upon the policy approaches that might be taken to reduce electricity emissions. Therefore, this report presents electricity emissions from both production and consumption perspectives. The difference in approaches are illustrated in Figure ES-3 as calculated by CTED based on data for 2002-2005 and Appendix A provides information on how the consumption-based approach was derived for other years in the inventory and projections.

Transportation

While transportation makes up a larger fraction of Washington's emissions – again, in large part as a result of the state's abundant hydroelectricity -- on a per capita basis, Washington consumes about the same amount of gasoline per capita as the US average. Per capita diesel fuel consumption in Washington is slightly lower than the national average. As shown in Figure ES-4, emissions associated with transportation are projected to be the largest contributor to future emissions growth from 2005 to 2020. The figure shows that transportation growth could add just over 12 MMtCO₂e to Washington's emissions by 2020.

Residential, Commercial and Industrial sectors

GHG emissions associated with energy consumption in residential, commercial, and industrial (RCI) sectors, including emissions from electricity consumption, are projected to increase through 2020. Growth in the residential, commercial and industrial sectors (including the electricity they consume) could add about 11 MMtCO₂e from 2005 to 2020 (5 MMtCO₂e from increased direct use of fuels and 6 MMtCO₂e from the emissions associated with electricity sold to RCI sectors), see figure ES-4.

Agriculture

Agricultural activities such as manure management, fertilizer use, and livestock (enteric fermentation) result in methane and nitrous oxide emissions that account for 6% of State GHG emissions in 2005. These emissions are projected to decrease by about 0.6 MMtCO₂e.

Industrial Processes

Industrial process emissions (including methane released from natural gas transmission and coal mining) comprise about 4% of State GHG emissions today. Emissions of PFCs from aluminum productions decreased from almost 6 MMtCO₂e in 1990 to less than 0.5 MMtCO₂e currently. The use of hydrofluorocarbons (HFCs) as substitutes for ozone-depleting substances (ODS) such as chlorofluorocarbons and hydrochlorofluorocarbons⁴, now accounts for a majority of process emissions, and are growing rapidly (GHG emissions from ODS substitutes are projected to more than double between now and 2020).

Waste Management

Emissions from solid waste and wastewater management account for less than 3% of Washington's emissions currently, and are projected to increase by just over 1 MMtCO₂e from 2005 to 2020.

For more discussion of historic Washington State GHG emissions trends, and the factors underlying these trends, see *Washington's Greenhouse Gas Emissions: Sources and Trends* (2006).⁵

⁴ Chlorofluorocarbons and hydrochlorofluorocarbons are also potent greenhouse gases; however they are not included in GHG estimates because of concerns related to implementation of the Montreal Protocol. See final Appendix.

⁵ *Washington's Greenhouse Gas Emissions: Sources and Trends*, by Stacey Waterman-Hoey and Greg Nothstein, WA State Dept. of Community, Trade & Economic Development, Energy Policy Division, dated December 2006

Carbon Sinks

Estimates of carbon sinks within Washington's forests and agricultural soils have also been included in this report. For forests, the current estimates are based on data from the U.S. Forest Service and indicate that about 29 MMtCO₂e are sequestered annually in Washington forest biomass. As described in Appendix H however, there is a significant degree of uncertainty in the size of the forest sink in Washington. The estimates presented here are believed to be at the high end of the possible range of sequestration estimates. Agricultural soils are estimated to store an additional 1.4 MMtCO₂e annually.

Black Carbon

Emissions of aerosols, such as "black carbon" from fossil fuel combustion, may have significant climate impacts through their effects on radiative forcing. However, there are, as yet, no widely-accepted methodologies for reflecting the impacts of aerosol emissions in terms of global warming potential (i.e. on a CO₂e basis)⁶; while some aerosols have overall warming effects, others have cooling impacts.

Appendix I to this report provides some preliminary estimates of aerosol emissions on a CO₂e basis, based on analysis for the Western Regional Air Partnership (WRAP). Given these very large uncertainties, black carbon emissions are not incorporated in the overall GHG emissions totals presented in this report.

Data Gaps and Unresolved Questions

Several data gaps and key unresolved questions regarding methodology and assumptions remain, particularly for the reference case projections. Areas for further review and refinement include:

- Estimates of the generation resources ("fuel mix") used to deliver electricity to Washington consumers.
- Key emissions drivers (such as transportation fuel use growth rates) used to estimate Washington's future GHG emissions.

⁶ The Intergovernmental Panel on Climate Change (IPCC) provides global warming potential (GWP) estimates for the gases

Table ES-1. Washington Historical and Reference Case GHG Emissions, by Sector^a

(Million Metric Tons CO ₂ e)	1990	2000	2005	2010	2020
Electricity, Net Consumption-based	16.9	23.3	18.9	20.2	24.9
Coal	16.8	17.4	15.2	15.9	18.4
Natural Gas	0.1	5.3	3.6	4.2	6.3
Petroleum	0.0	0.6	0.0	0.1	0.2
Biomass and Waste (CH ₄ and N ₂ O)	0.0	0.0	0.0	0.0	0.0
Residential/Commercial/Industrial (RCI)	18.6	20.3	19.4	21.3	24.3
Coal	0.6	0.3	0.2	0.3	0.3
Natural Gas	8.6	11.4	10.3	11.0	12.7
Oil	9.1	8.4	8.5	9.7	11.0
Wood (CH ₄ and N ₂ O)	0.2	0.2	0.3	0.4	0.4
Transportation	37.5	45.9	44.5	48.5	56.9
Onroad Gasoline	20.4	24.5	24.8	26.2	29.1
Onroad Diesel	4.1	7.6	7.5	8.8	12.0
Marine Vessels	2.6	2.9	3.0	3.3	4.1
Jet Fuel and Aviation Gasoline	9.1	10.0	7.8	8.1	8.5
Rail	0.8	0.3	0.8	0.8	0.8
Natural Gas, LPG, other	0.6	0.6	0.7	1.3	2.5
Fossil Fuel Industry	0.5	0.7	0.9	1.0	1.1
Natural Gas Industry (CH ₄)	0.4	0.7	0.9	0.9	1.0
Coal Mining (CH ₄)	0.0	0.0	0.0	0.0	0.0
Industrial Processes	7.0	6.6	3.3	4.2	6.2
Cement Manufacture (CO ₂)	0.2	0.5	0.5	0.5	0.5
Aluminum Production (CO ₂ , PFC)	5.9	3.9	0.4	0.4	0.3
Limestone and Dolomite Use (CO ₂)	0.0	0.0	0.0	0.0	0.0
Soda Ash (CO ₂)	0.1	0.1	0.1	0.1	0.1
ODS Substitutes (HFC, PFC, and SF ₆)	0.0	1.6	2.1	3.0	5.1
Semiconductor Manufacturing (HFC, PFC, and SF ₆)	0.0	0.1	0.0	0.0	0.0
Electric Power T & D (SF ₆)	0.8	0.4	0.3	0.2	0.1
Waste Management	1.5	2.2	2.4	2.8	3.6
Solid Waste Management	1.0	1.5	1.8	2.0	2.7
Wastewater Management	0.5	0.6	0.7	0.8	0.9
Agriculture	6.4	6.4	5.4	5.1	4.8
Enteric Fermentation	2.0	1.8	1.6	1.5	1.3
Manure Management	0.7	0.9	0.9	1.0	1.2
Agricultural Soils	3.7	3.8	2.8	2.6	2.2
Total Gross Emissions	88.4	105.4	94.8	103.0	121.9
<i>increase relative to 1990</i>		<i>19%</i>	<i>7%</i>	<i>17%</i>	<i>38%</i>
Forestry and Land Use	-28.6	-28.6	-28.6	-28.6	-28.6
Agricultural Soils	-1.4	-1.4	-1.4	-1.4	-1.4
Net Emissions (including sinks*)	58.4	75.4	64.8	73.0	91.9

^a Totals may not equal exact sum of subtotals shown in this table due to independent rounding. n/a = not available, GHG emissions from solid waste and wastewater management are not yet available due to updates to the approach for estimating emissions for these activities.

^b Residential, Commercial and Industrial sectors.

Figure ES-1. Historical Washington and U.S. GHG Emissions, Per Capita and Per Unit Gross Product, 1990-2005

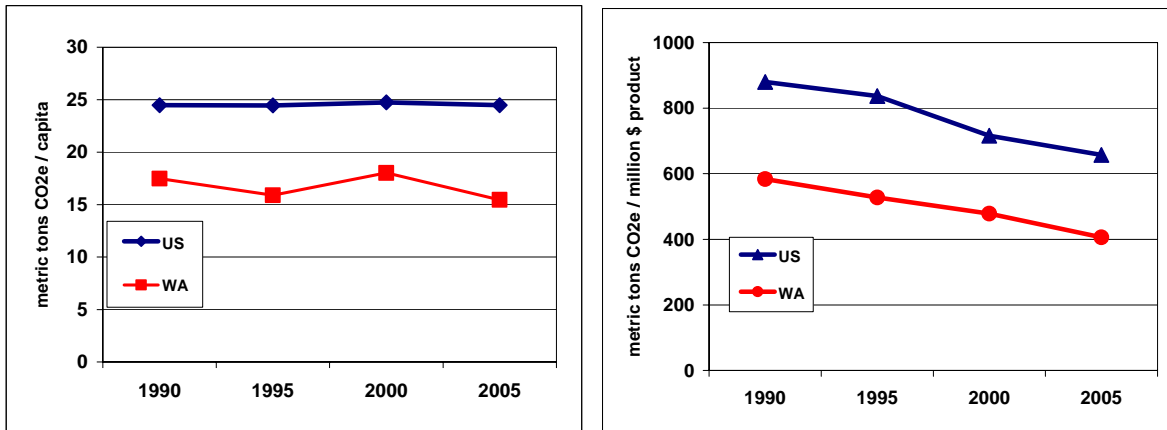


Figure ES-2. Washington Gross GHG Emissions by Sector, 1990-2020: Historical and Projected (consumption-based)

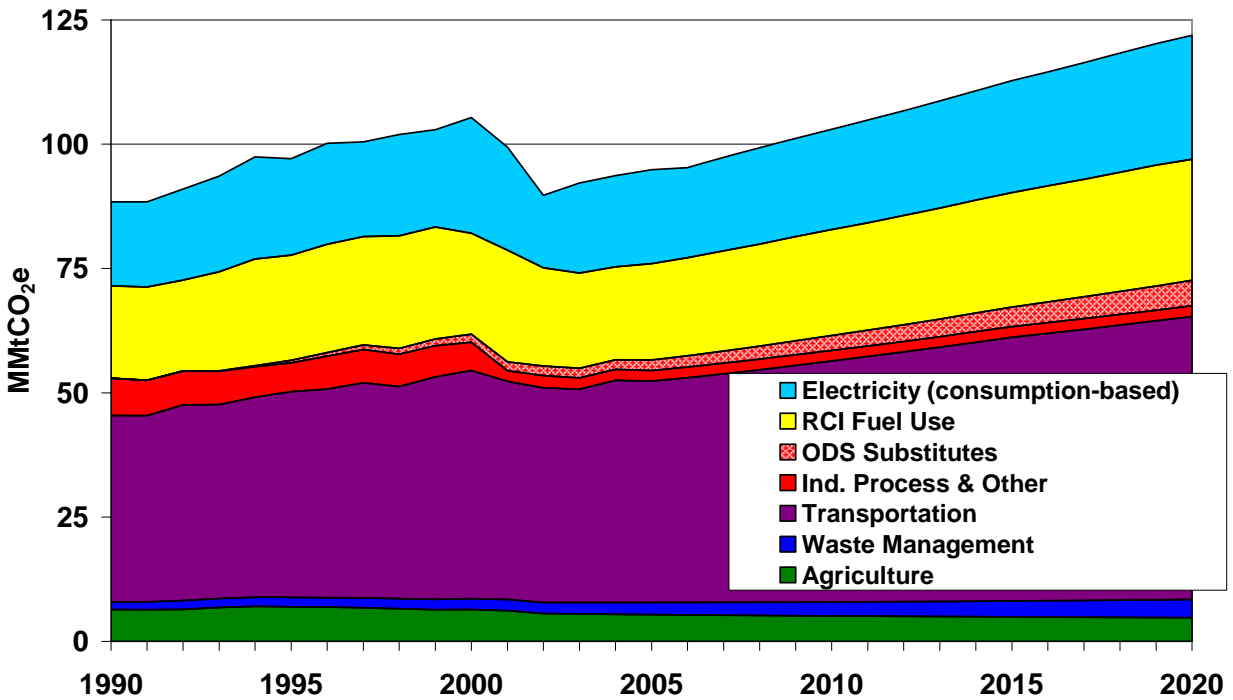
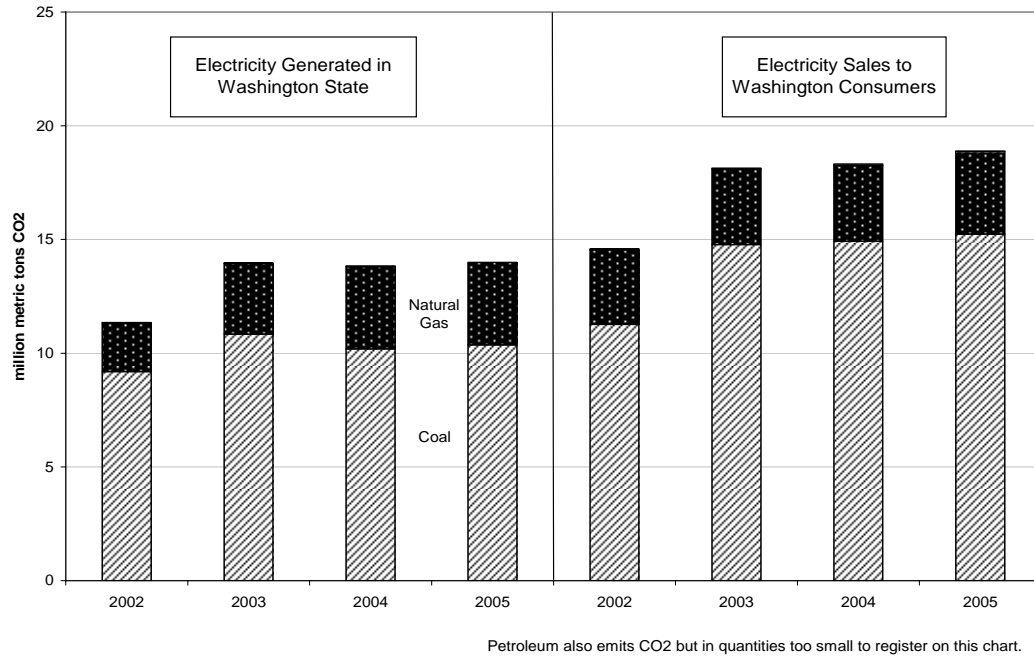


Figure ES-3. GHG Emissions from Washington Electric Sector 2002-2005, Production-based (Electricity Generated) and Consumption-based (Electricity Sales)



Source: CTED 2006

Figure ES-4. Sector Contributions to Emissions Growth in Washington, 1990-2020: Reference Case Projections

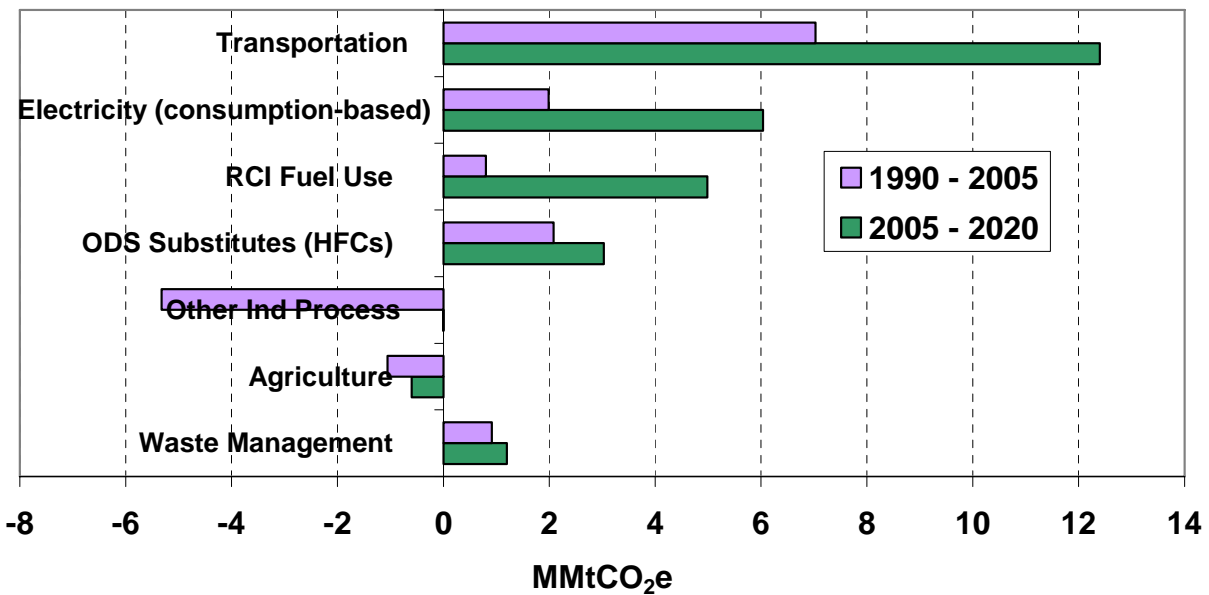


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Acronyms and Key Terms

AEO – *Annual Energy Outlook, EIA*

Ag – Agriculture

bbls – Barrels

BC – Black Carbon

Bcf – Billion Cubic Feet

BLM – United States Bureau of Land Management

BTU – British Thermal Unit

C – Carbon

CaCO₃ – Calcium Carbonate

CBM – Coal Bed Methane

CCS – Center for Climate Strategies

CFCs – Chlorofluorocarbons

CH₄ – Methane*

CO₂ – Carbon Dioxide*

CO₂e – Carbon Dioxide Equivalent*

CRP – Federal Conservation Reserve Program

EC – Elemental Carbon

eGRID – U.S. EPA's Emissions & Generation Resource Integrated Database

EIA – U.S. DOE Energy Information Administration

EIIP – Emissions Inventory Improvement Project (US EPA)

FIA – Forest Inventory Analysis

GHG – Greenhouse Gases*

GSP – Gross State Product

GWh – Gigawatt-hour

GWP - Global Warming Potential*

HFCs – Hydrofluorocarbons*

HNO₃ – Nitric Acid

HWP – Harvested Wood Products

IPCC – Intergovernmental Panel on Climate Change*

kWh – Kilowatt-hour

LFGTE – Landfill Gas Collection System and Landfill-Gas-to-Energy

LMOP – Landfill Methane Outreach Program

LNG – Liquefied Natural Gas

LPG – Liquefied Petroleum Gas

Mg – Megagrams (equivalent to one metric ton)

Mt - Metric Ton (equivalent to 1.102 short tons)

MMt – Million Metric Tons

MPO – Metropolitan Planning Organization

MSW – Municipal Solid Waste

MW – Megawatt

N – Nitrogen

N₂O – Nitrous Oxide*

NO₂ – Nitrogen Dioxide*

NAICS – North American Industry Classification System

NASS – National Agricultural Statistics Service

NO_x – Nitrogen Oxides

NSCR – Non-selective Catalytic Reduction

ODS – Ozone-Depleting Substances

OM – Organic Matter

PADD – Petroleum Administration for Defense Districts

PFCs – Perfluorocarbons*

PM – Particulate Matter

ppb – parts per billion

ppm – parts per million

ppt – parts per trillion

PV – Photovoltaic

RCI – Residential, Commercial, and Industrial

SAR – Second Assessment Report

SCR- Selective Catalytic Reduction

SED – State Energy Data

SF₆ – Sulfur Hexafluoride*

SGIT – State Greenhouse Gas Inventory Tool

Sinks – Removals of carbon from the atmosphere, with the carbon stored in forests, soils, landfills, wood structures, or other biomass-related products.

TAR – Third Assessment Report

T&D – Transmission and Distribution

TWh – Terawatt-hours

UNFCCC – United Nations Framework Convention on Climate Change

U.S. EPA – United States Environmental Protection Agency

U.S. DOE – United States Department of Energy

USDA – United States Department of Agriculture

USFS – United States Forest Service

USGS – United States Geological Survey

VMT – Vehicle-Miles Traveled

WAPA – Western Area Power Administration

WECC – Western Electricity Coordinating Council

W/m² – Watts per Square Meter

WMO – World Meteorological Organization*

WSDOT – Washington State Department of Transportation

WRAP – Western Regional Air Partnership

* - See Appendix J for more information

Summary of Preliminary Findings

Introduction

The Center for Climate Strategies (CCS) prepared this report for the Washington Department of Ecology (Ecology) under an agreement with the Western Governors' Association, and with input from the Departments of Ecology and Community, Trade and Economic Development. This report presents initial estimates of base year and projected Washington anthropogenic greenhouse gas (GHG) emissions and sinks for the period from 1990 to 2020. These estimates are intended to assist the State with an initial, comprehensive understanding of current and possible future GHG emissions for Washington, and, thereby, to inform future analysis and design of GHG mitigation strategies.

Historical GHG emissions estimates (1990 through 2005)⁷ were developed using a set of generally accepted principles and guidelines for state GHG emissions inventories, as described in the Approach section below, relying to the extent possible on Washington-specific data and inputs. The initial reference case projections (2006-2020) are based on a set of existing projections of electricity generation, fuel use, and other GHG-emitting activities, along with a set of simple, transparent assumptions described in the appendices of this report.

This report covers the six types of gases included in the U.S. Greenhouse Gas Inventory:

1. Carbon dioxide (CO₂),
2. Methane (CH₄),
3. Nitrous oxide (N₂O),
4. Hydrofluorocarbons (HFCs),
5. Perfluorocarbons (PFCs), and
6. Sulfur hexafluoride (SF₆).

Emissions of these GHGs are presented using a common metric, CO₂ equivalence (CO₂e), which indicates the relative contribution of each gas to global average radiative forcing on a Global Warming Potential (GWP) weighted basis. The final appendix to this report provides a more complete discussion of GHGs and GWPs. Emissions of black carbon were also estimated. Black carbon is an aerosol species with a positive climate forcing potential (that is, the potential to warm the atmosphere, as GHGs do); however, black carbon currently does not have a GWP defined by the IPCC due to uncertainties in both the direct and indirect effects of BC on atmospheric processes (see Appendices I and J for more details).

It is important to note that the preliminary emission estimates reflect the *GHG emissions associated with the electricity sources used to meet Washington's demands*, corresponding to a *consumption-based* approach to emissions accounting (see Approach Section below). Another way to look at electricity emissions is to consider the *GHG emissions produced by electricity generation facilities in the State*. For many years, Washington power plants have tended to produce more electricity than is consumed in the State; emissions associated with exported electricity are excluded from the consumption-based emissions. This report covers both methods

⁷ The last year of available historical data varies by sector; ranging from 2000 to 2005.

of accounting for emissions, but for consistency, all total results are reported as *consumption-based*.

Washington Greenhouse Gas Emissions: Sources and Trends

Table 1 provides a summary of GHG emissions estimated for Washington by sector for the years 1990, 2000, 2005, 2010, and 2020. In the sections below, we discuss GHG emission sources (positive, or *gross*, emissions) and sinks (negative emissions) separately in order to identify trends, projections and uncertainties for each.

This report is divided into the following sections:

1. Historical emissions (1990 through 2005).
 2. Forecasted reference-case projection-year emissions (2006 through 2020).
 3. Key uncertainties and next steps.
 4. General methodology, principles, and guidelines used to prepare the inventories.
- Appendices A through H provide the detailed methods, data sources, and assumptions for each GHG sector.
 - Appendix I provides information on 2002 and 2018 black carbon emissions for Washington.
 - Appendix J provides background information on GHGs and climate-forcing aerosols.

Historical Emissions

Overview

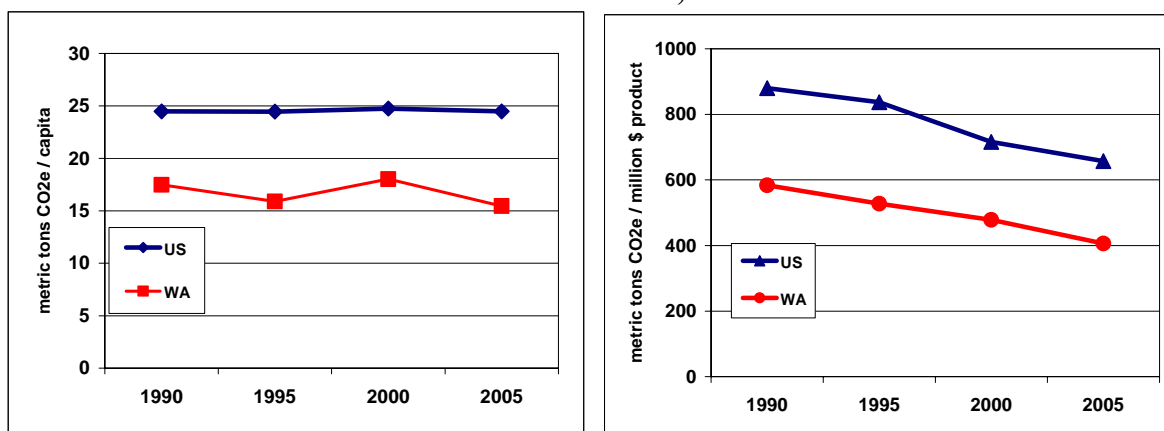
Our analyses suggest that in 2005, activities in Washington accounted for approximately 95 million metric tons (MMt) of *gross*⁸ CO₂e emissions in 2005, an amount equal to 1% of total U.S. gross GHG emissions.⁹ Washington's gross GHG emissions in 2005 were about 7% greater than emissions in 1990, following a 10% decrease from 2000 to 2005.

On a per capita basis, Washington emitted about 15 metric tons (Mt) of CO₂e per person in 2005, lower than the national average of 25 MtCO₂e/yr. Figure 1 illustrates the State's emissions per capita and per unit of economic output. Per capita emissions in Washington have varied between 15 and 18 MtCO₂e per capita since 1990, largely in the electric and industrial sector. On the other hand, economic growth exceeded emissions growth throughout the 1990-2005 period (leading to declining GHG emissions per unit of state product). The trends in Washington's emissions per gross state product parallel those for the nation on average, in this time period.

⁸ Excluding GHG emissions removed due to forestry and other land uses and excluding GHG emissions associated with exported electricity.

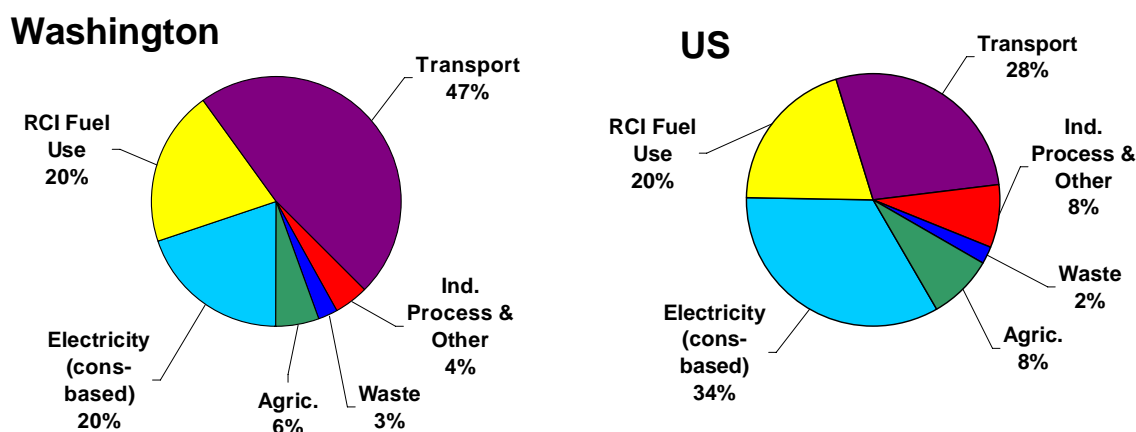
⁹ GHG emissions from solid waste and wastewater management are excluded from totals due to pending updates to the approach for estimating emissions for these activities.

Figure 1. Historical Washington and U.S. GHG Emissions, Per Capita and Per Unit Gross Product, 1990-2005



Electricity use, transportation and residential/commercial/industrial (RCI) fossil fuel combustion are the State's principal GHG emissions sources. A comparison of Washington and U.S. emissions for 2005 is shown in Figure 2 below, which shows that in Washington a much larger fraction of the GHG emissions are due to transportation activities. The large amount of hydro-electric generation in the State leads to lower contribution of the electric sector to total emissions, compared with the national average.

Figure 2. Gross GHG Emissions by Sector, 2005, Washington and US



Forestry and agricultural soils in Washington are estimated to result in an annual net sink of almost 30 MMtCO₂e in 2005.

The 1990-2004 historical emission estimates are comparable to estimates previously prepared by CTED.¹⁰ The main difference is the use of consumption-based emissions for the electric sector.

¹⁰ *Washington's Greenhouse Gas Emissions: Sources and Trends*, Stacey Waterman-Hoey and Greg Nothstein, WA State Dept. of Community, Trade & Economic Development, Energy Policy Division, December 2006.

A Closer Look at Two of the Major Sources: Electricity and Transportation.

Emissions from Electricity Consumption

As shown in Table 1, electricity use accounted for about 20% of Washington's gross GHG emissions in 2005 (19 MMtCO₂e), which was lower than the national share of emissions from electricity production (34%).¹¹ In total (across the residential, commercial and industrial sectors), Washington has a higher per capita use of electricity than the U.S. as a whole (13,000 kWh per person per year compared to 12,000 kWh/person-yr nationally). However, hydro-electric generation accounts for a large fraction of the electricity delivered to Washington's consumers. With no GHG emissions associated with this electricity source, Washington emits relatively low rates of GHGs per unit of electricity sold.

Consumption-based Approach vs. Production-based Approach

It is important to note that these preliminary electricity emissions estimates reflect the *GHG emissions associated with the electricity sources used to meet Washington demands*, corresponding to a *consumption-based* approach to emissions accounting (see Section 2). Another way to look at electricity emissions is to consider the *GHG emissions produced by electricity generation facilities in the State*. GHG emissions from Washington's electricity plants are estimated at about 14 MMtCO₂e in 2005. The difference between the consumption-based and production-based emissions reflects, in part, that Washington imports more electricity from fossil fuel-based plants than it exports.

While GHG emissions associated with both electricity production and consumption have been estimated in this report, unless otherwise indicated, tables, figures, and totals in this report reflect electricity consumption-based emissions. The consumption-based approach can better reflect the emissions (and emissions reductions) associated with activities occurring in the State, particularly with respect to electricity use (and efficiency improvements), and is particularly useful for policy-making. Under this approach, emissions associated with electricity exported to other States would need to be covered in those States' accounts in order to avoid double-counting or exclusions. (Indeed, Arizona, California, Oregon, New Mexico, and Washington are currently considering such an approach.)

Emissions from Transportation

While transportation makes up a larger fraction of Washington's emissions – again, because of the state's abundant hydroelectricity – on a per capita basis, Washington consumes about the same amount of gasoline as the US average. Per capita diesel fuel consumption in Washington is slightly lower than the national average. GHG emissions from transportation fuel use have risen steadily since 1990 at an average rate of slightly over 1% annually. Gasoline-powered vehicles accounted for about 56% of transportation GHG emissions in 2005. On-road diesel vehicles accounted for 17% of emissions and air travel for another 17%. Marine, locomotives, and other sources [natural gas and liquefied petroleum gas (LPG) vehicles and lubricants] accounted for

<http://www.cted.wa.gov/DesktopModules/CTEDPublications/CTEDPublicationsView.aspx?tabID=0&ItemID=4084&Mid=863&wversion=Staging>

¹¹ Unlike for Washington, for the U.S. as a whole, there is relatively little difference between the emissions from electricity use and emissions from electricity production, as the U.S. imports only about 1% of its electricity, and exports far less.

the remaining 10% of transportation emissions. As the result of Washington's population and economic expansion and an increase in total vehicle miles traveled during the 1990s, on-road gasoline use grew by 23% between 1990 and 2005. Meanwhile, on-road diesel use increased by 98% during this period, suggesting an even more rapid growth in freight movement within the State. Aviation fuel use declined from 1990-2005.

Reference Case Projections

Relying on a variety of sources for projections of electricity and fuel use, as noted below and in the Appendices, we developed a simple reference case projection of GHG emissions through 2020. As illustrated in Figure 3 and shown numerically in Table ES-1, under the reference case projections, Washington gross GHG emissions continue to grow steadily, climbing to 122 MMtCO₂e by 2020, about 38% above 1990 levels.

Transportation

As shown in Figures 3 and 4, emissions associated with transportation are projected to be the largest contributor to future emissions growth from 2005 to 2020. The figure shows that transportation growth could add over 12 MMtCO₂e to Washington's emissions by 2020.

Residential, Commercial and Industrial, including electricity consumption

Growth in energy consumption in the residential, commercial and industrial sectors could add about 5 MMtCO₂e from increased direct use of fuels and 6 MMtCO₂e from the emissions associated with electricity sold to RCI sectors, see figure 4.

Agriculture

Agricultural activities such as manure management, fertilizer use, and livestock (enteric fermentation) result in methane and nitrous oxide emissions are projected to decrease by about 0.6 MMtCO₂e.

Industrial Processes

Industrial process emissions (including methane released from natural gas transmission and coal mining) are projected to grow by 3 MMtCO₂e. Most of the growth is due to the use of hydrofluorocarbons (HFCs) as substitutes for ozone-depleting substances (ODS) such as chlorofluorocarbons and hydrochlorofluorocarbons.¹² GHG emissions from ODS substitutes are projected to more than double between now and 2020. Emissions from solid waste and wastewater management account for less than 3% of Washington's emissions currently, and are projected to increase by just over 1 MMtCO₂e from 2005 to 2020.

¹² Chlorofluorocarbons and hydrochlorofluorocarbons are also potent greenhouse gases; however they are not included in GHG estimates because of concerns related to implementation of the Montreal Protocol. See final Appendix.

Table 1. Washington Historical and Reference Case GHG Emissions, by Sector^a

(Million Metric Tons CO₂e)	1990	2000	2005	2010	2020
Electricity, Net Consumption-based	16.9	23.3	18.9	20.2	24.9
Coal	16.8	17.4	15.2	15.9	18.4
Natural Gas	0.1	5.3	3.6	4.2	6.3
Petroleum	0.0	0.6	0.0	0.1	0.2
Biomass and Waste (CH ₄ and N ₂ O)	0.0	0.0	0.0	0.0	0.0
Residential/Commercial/Industrial (RCI)	18.6	20.3	19.4	21.3	24.3
Coal	0.6	0.3	0.2	0.3	0.3
Natural Gas	8.6	11.4	10.3	11.0	12.7
Oil	9.1	8.4	8.5	9.7	11.0
Wood (CH ₄ and N ₂ O)	0.2	0.2	0.3	0.4	0.4
Transportation	37.5	45.9	44.5	48.5	56.9
On-road Gasoline	20.4	24.5	24.8	26.2	29.1
On-road Diesel	4.1	7.6	7.5	8.8	12.0
Marine Vessels	2.6	2.9	3.0	3.3	4.1
Jet Fuel and Aviation Gasoline	9.1	10.0	7.8	8.1	8.5
Rail	0.8	0.3	0.8	0.8	0.8
Natural Gas, LPG, other	0.6	0.6	0.7	1.3	2.5
Fossil Fuel Industry	0.5	0.7	0.9	1.0	1.1
Natural Gas Industry (CH ₄)	0.4	0.7	0.9	0.9	1.0
Coal Mining (CH ₄)	0.0	0.0	0.0	0.0	0.0
Industrial Processes	7.0	6.6	3.3	4.2	6.2
Cement Manufacture (CO ₂)	0.2	0.5	0.5	0.5	0.5
Aluminum Production (CO ₂ , PFC)	5.9	3.9	0.4	0.4	0.3
Limestone and Dolomite Use (CO ₂)	0.0	0.0	0.0	0.0	0.0
Soda Ash (CO ₂)	0.1	0.1	0.1	0.1	0.1
ODS Substitutes (HFC, PFC, and SF ₆)	0.0	1.6	2.1	3.0	5.1
Semiconductor Manufacturing (HFC, PFC, and SF ₆)	0.0	0.1	0.0	0.0	0.0
Electric Power T & D (SF ₆)	0.8	0.4	0.3	0.2	0.1
Waste Management	1.5	2.2	2.4	2.8	3.6
Solid Waste Management	1.0	1.5	1.8	2.0	2.7
Wastewater Management	0.5	0.6	0.7	0.8	0.9
Agriculture	6.4	6.4	5.4	5.1	4.8
Enteric Fermentation	2.0	1.8	1.6	1.5	1.3
Manure Management	0.7	0.9	0.9	1.0	1.2
Agricultural Soils	3.7	3.8	2.8	2.6	2.2
Total Gross Emissions	88.4	105.4	94.8	103.0	121.9
<i>increase relative to 1990</i>		<i>19%</i>	<i>7%</i>	<i>17%</i>	<i>38%</i>
Forestry and Land Use	-28.6	-28.6	-28.6	-28.6	-28.6
Agricultural Soils	-1.4	-1.4	-1.4	-1.4	-1.4
Net Emissions (including sinks*)	58.4	75.4	64.8	73.0	91.9

^a Totals may not equal exact sum of subtotals shown in this table due to independent rounding. n/a = not available, , GHG emissions from solid waste and wastewater management are not yet available due to updates to the approach for estimating emissions for these activities.

^b Residential, Commercial and Industrial sectors.

Figure 3. Washington Gross GHG Emissions by Sector, 1990-2020: Historical and Projected (consumption-based)

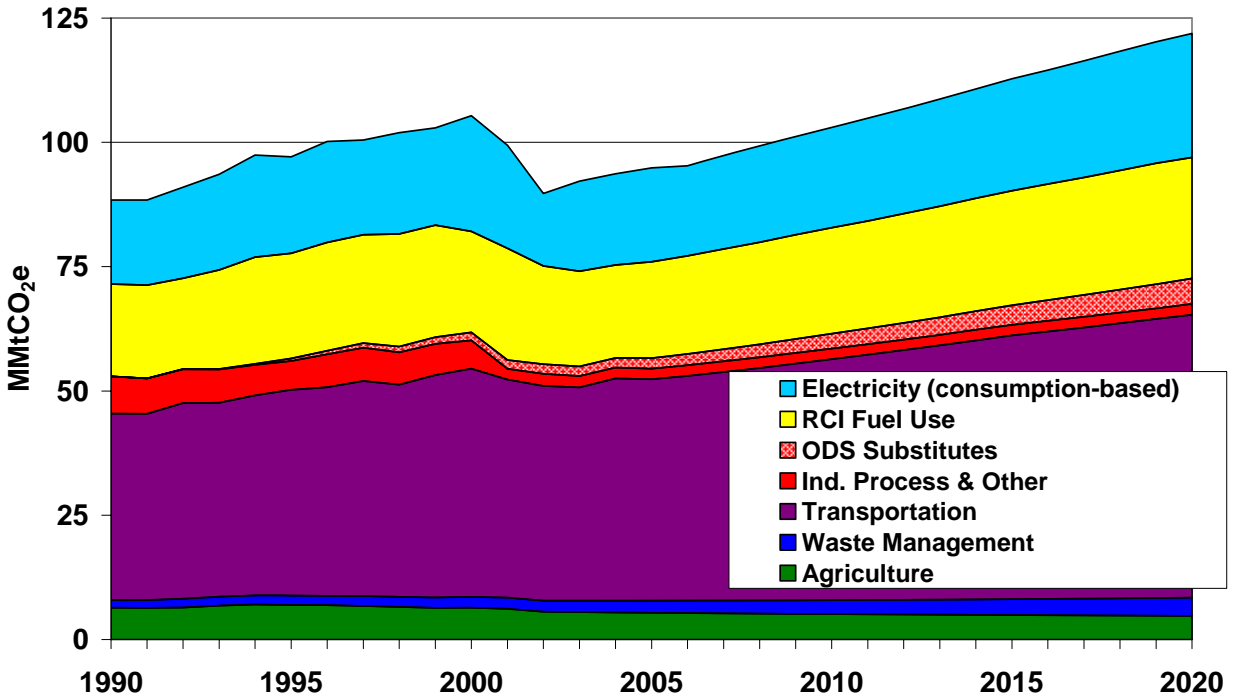
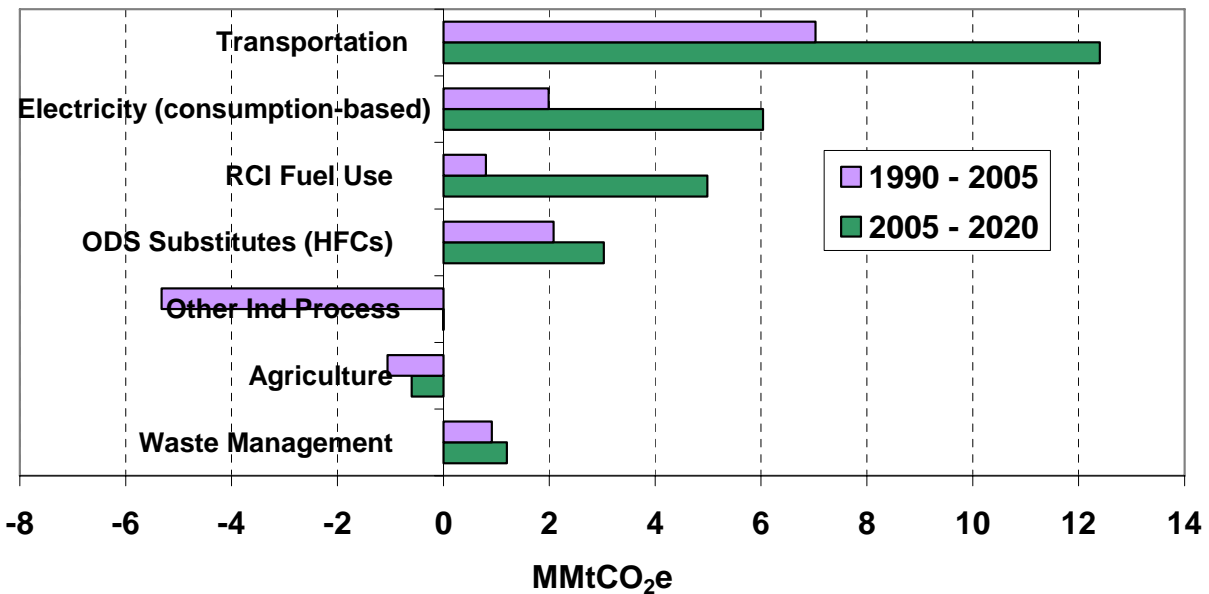


Figure 4. Sector Contributions to Emissions Growth in Washington, 1990-2020: Reference Case Projections



Key Uncertainties and Next Steps

Some data gaps exist in this analysis, particularly for the reference case projections. Key refinements include review and revision of key emissions drivers (such as transportation fuel use growth rates) that will be major determinants of Washington's future GHG emissions. These growth rates are driven by uncertain economic, demographic, and land use trends (including growth patterns and transportation system impacts), all of which deserve closer review and discussion. Other refinements include improved estimates of GHG emissions associated with electricity consumption. Finally, uncertainty remains regarding the estimates for historic GHG sinks from forestry, and projections for these emissions will greatly affect the net GHG emissions attributed to Washington. We expect that Washington's ongoing climate change action planning process will shed light on these issues.

Table 3. Key Annual Growth Rates for Washington, Historical and Projected

Key Parameter	1990-2005	2005-2020	Sources
Population	1.7%	1.5%	The State of Washington, Office of Financial Management
Employment			Washington State Employment Security Department
Goods	0.8%	1.1%	
Services	2.1%	0.9%	
Electricity Sales	-0.6%	1.3%	EIA data for 1990-2005, Projections based on information from Northwest Power and Conservation Council and Utility plans (see Appendix A)
Vehicle Miles Traveled	1.9%	2.0%	Washington State Department of Transportation

* Population and employment projections for Washington were used together with US DOE's Annual Energy Outlook 2006 projections of changes in fuel use on a per capita and per employee, as relevant for each sector. For instance, growth in Washington's residential natural gas use is calculated as the Washington population growth times the change in per capita natural gas use for the Mountain region.

Approach

The principal goal of compiling the inventories and reference case projections presented in this document is to provide the State with a general understanding of Washington's historical, current, and projected (expected) GHG emissions. The following explains the general methodology and the general principles and guidelines followed during development of these GHG inventories for Washington.

General Methodology

CCS prepared this analysis in close consultation with Washington agencies, in particular, with the CTED and Ecology staff. The overall goal of this effort is to provide simple and straightforward estimates, with an emphasis on robustness, consistency, and transparency. As a result, we rely on reference forecasts from best available state and regional sources where

possible. Where reliable forecasts are lacking, we use straightforward spreadsheet analysis and linear extrapolations of historical trends rather than complex modeling.

In most cases, we follow the same approach to emissions accounting for historical inventories used by the U.S. EPA in its national GHG emissions inventory¹³ and its guidelines for States.¹⁴ These inventory guidelines were developed based on the guidelines from the Intergovernmental Panel on Climate Change, the international organization responsible for developing coordinated methods for national GHG inventories.¹⁵ The inventory methods provide flexibility to account for local conditions. The key sources of activity and projection data are shown in Table 4.

Table 4 also provides the descriptions of the data provided by each source and the uses of each data set in this analysis.

General Principles and Guidelines

A key part of this effort involves the establishment and use of a set of generally accepted accounting principles for evaluation of historical and projected GHG emissions, as follows:

- **Transparency.**
We report data sources, methods, and key assumptions to allow open review and opportunities for additional revisions later based on input from others. In addition, we report key uncertainties where they exist.
- **Consistency.**
To the extent possible, the inventory and projections will be designed to be externally consistent with current or likely future systems for state and national GHG emission reporting. We have used the EPA tools for state inventories and projections as a starting point. These initial estimates were then augmented and/or revised as needed to conform with state-based inventory and base-case projection needs. For consistency in making reference case projections¹⁶, we define reference case actions for the purposes of projections as those *currently in place or reasonably expected over the time period of analysis*.
- **Comprehensive Coverage of Gases, Sectors, State Activities, and Time Periods.**
This analysis aims to comprehensively cover GHG emissions associated with activities in Washington. It covers all six GHGs covered by U.S. and other national inventories:

¹³ U.S. EPA, Feb 2005. *Draft Inventory of US Greenhouse Gas Emissions and Sinks: 1990-2003*. <http://yosemite.epa.gov/oar/globalwarming.nsf/content/ResourceCenterPublicationsGHGEmissionsUSEmissionsInventory2005.html>.

¹⁴ <http://yosemite.epa.gov/oar/globalwarming.nsf/content/EmissionsStateInventoryGuidance.html>.

¹⁵ <http://www.ipcc-nggip.iges.or.jp/public/gl/invs1.htm>.

¹⁶ “Reference case” refers to a projection of the current or “base year” inventory to one or more future years under business-as-usual forecast conditions (for example, existing control programs and economic growth).

Source	Information provided	Use of Information in this Analysis
<i>Washington's Greenhouse Gas Emissions: Sources and Trends</i> ¹⁷	GHG emissions from energy consumption (including electric sector) and industrial processes for 1990-2004.	GHG emissions from the Washington state inventory were used directly in this analysis
<i>Washington Fuel Mix Disclosure Data</i>	Mix of resources used to provide electricity for Washington consumers http://www.cted.wa.gov/site/539/default.aspx	Estimates of GHG emissions from electricity consumption for 2000, 2001, 2002 and 2006.
U.S. EPA State Greenhouse Gas Inventory Tool (SGIT)	US EPA SGIT is a collection of linked spreadsheets designed to help users develop State GHG inventories. US EPA SGIT contains default data for each State for most of the information required for an inventory. The SGIT methods are based on the methods provided in the Volume 8 document series published by the Emissions Inventory Improvement Program (http://www.epa.gov/ttn/chiep/eiip/techreport/volume08/index.html)	Where not indicated otherwise, SGIT is used to calculate emissions from agriculture and forestry, and waste. We use SGIT emission factors (CO ₂ , CH ₄ and N ₂ O per BTU consumed) to calculate energy use emissions.
U.S. DOE Energy Information Administration (EIA) State Energy Data (SED)	EIA SED source provides energy use data in each State, annually to 2004 or in some cases 2005).	EIA SED is the source for most energy use data. We also use the more recent data for electricity and natural gas consumption (including natural gas for vehicle fuel) from the EIA website for years after 2001. Emission factors from US EPA SGIT are used to calculate energy-related emissions.
U.S. DOE Energy Information Administration Annual Energy Outlook 2006 (AEO2006)	EIA AEO2006 projects energy supply and demand for the U.S. from 2005 to 2030. Energy consumption is estimated on a regional basis. Washington is included in the Pacific Census region (AK, CA, HI, OR, WA)	EIA AEO2006 is used to project changes in per capita (residential) and per employee (commercial/industrial) energy consumption
Office of Pipeline Security (OPS), Distribution and Transmission Annals	Natural gas transmission and distribution pipeline mileage.	Pipeline mileage from OPS used with SGIT to estimate natural gas transmission and distribution emissions.
U.S. EPA Landfill Methane Outreach Program (LMOP)	LMOP provides landfill waste-in-place data.	Waste-in-place data used to estimate annual disposal rate, which was used with SGIT to estimate emissions from solid waste).
U.S. Forest Service	Data on forest carbon stocks for multiple years.	Data are used to calculate carbon dioxide flux over time (terrestrial CO ₂ sequestration in forested areas)
USDS National Agricultural Statistics Service (NASS)	USDA NASS provides data on crops and livestock.	Crop production data used to estimate agricultural residue and agricultural soils emissions; livestock population data used to estimate manure and enteric fermentation emissions

¹⁷ Waterman-Hoey and Nothstein, Department of Community, Trade and Economic Development. December 2006

- CO₂, CH₄, N₂O, SF₆, HFCs, and PFCs and black carbon. The inventory estimates are for the year 1990, with subsequent years included up to most recently available data (typically 2002 to 2005), with projections to 2010 and 2020.
- **Priority of Significant Emissions Sources:** In general, activities with relatively small emissions levels may not be reported with the same level of detail as other activities.
- **Priority of Existing State and Local Data Sources:** In gathering data and in cases where data sources conflicted, we placed highest priority on local and state data and analyses, followed by regional sources, with national data or simplified assumptions such as constant linear extrapolation of trends used as defaults where necessary.
- **Use of Consumption-Based Emissions Estimates:** To the extent possible, we estimated emissions that are caused by activities that occur in Washington. For example, we reported emissions associated with the electricity consumed in Washington. The rationale for this method of reporting is that it can more accurately reflect the impact of State-based policy strategies such as energy efficiency on overall GHG emissions, and it resolves double counting and exclusion problems with multi-emissions issues. This approach can differ from how inventories are compiled, for example, on an in-state production basis, in particular for electricity.

For electricity, we estimate, as well as the emissions due to fuels combusted at electricity plants in the State, the emissions related to electricity *consumed* in Washington. This entails accounting for the electricity sources used by Washington utilities to meet consumer demands. CTED has collected fuel mix data from the utilities for 2002 to 2005 and a simplified approach was used to estimate historic and future consumption-based emissions.

If further refinement of this analysis could include estimating other sectors emissions on a consumption basis, such as accounting for emissions from combustion of transportation fuel used in Washington, but purchased out-of-state. In some cases this can require venturing into the relatively complex terrain of life-cycle analysis. In general, a consumption-based approach is recommended where it will significantly improve the estimation of the emissions impact of potential mitigation strategies. (For example re-use, recycling, and source reduction can lead to emission reductions resulting from lower energy requirements for material production (such as paper, cardboard, and aluminum), even though production of those materials, and emissions associated with materials production, may not occur within the State.)

Details on the methods and data sources used to construct the inventories and forecasts for each source sector are provided in the following appendices:

- Appendix A. Electricity Use and Supply;
- Appendix B. Residential, Commercial, and Industrial (RCI) Fossil Fuel Combustion;
- Appendix C. Transportation Energy Use;
- Appendix D. Industrial Processes;
- Appendix E. Fugitive Emissions from Fossil Fuel Industries;
- Appendix F. Agriculture;
- Appendix G. Waste Management; and
- Appendix H. Forestry.
- Appendix I. Black carbon emissions
- Appendix J. Additional background information from the U.S. EPA on greenhouse gases and global warming potential values.

Appendix A. Electricity Use and Supply

Washington's electricity load is met through facilities both in-state and out-of-state. Hydro-electric generation meets the majority of the load, accounting for over 65% of the electricity provided for the state. Coal, natural gas, and oil provide another 25% to 27% with nuclear accounting for approximately 5%. Renewable generation – biomass, wind, landfill gas, and geothermal – provide the remainder of Washington's electricity needs and their contribution is expected to grow in the future.

The mix of electricity generated in Washington is similar to the mix of electricity supplied to the State's customers. Hydro-electric generation dominates even more, accounting for over 70% of electricity generation. The Centralia coal plant accounts for another 10% of generation, and about 80% of the state's GHG emissions from power production. Most of the remaining generation, and the primary source of recent growth in capacity in the State, is natural gas and wind power. Hydropower has largely reached its maximum potential in Washington; no large new projects are expected to be built in the future, though increased generation from existing facilities is possible.

While the operation of hydro facilities releases no GHG emissions, seasonal and annual variations in hydro availability can indirectly affect the operation and thus emissions from other, fossil-fueled generation. The historical variation in hydro-electricity production largely explains the wide swings in emissions from the electric sector (see charts below), and future availability of hydro-electricity could thus have a considerable effect on emissions as well.

As noted earlier, one of the key questions for the State to consider is how to treat GHG emissions that result from generation of electricity that is produced in Washington to meet electricity needs in other states, and vice-versa (GHG emissions from electricity generated in other states to meet Washington electricity demand). In other words, should the State consider the GHG emissions associated with the State's electricity consumption or its electricity production, or some combination of the two? Since many discussions on Washington's climate change strategies emphasize the consumption (load-based) approach, and because the state's inventory and emissions goals are based on this perspective, this section first examines GHG emissions from this perspective. It then considers GHG emission estimates from the production-basis perspective, which is how national inventories are compiled and is germane to some climate policy options, such as a generation-based cap-and-trade system. .

This appendix assesses Washington's electricity sector in terms of consumption and production emissions, and describes the assumptions used to develop the reference case projections. As noted previously, the Reference Case should be viewed as a "no recent policy" baseline, against which the benefits of policies, both those recently enacted and those to be recommended by the CAT can be assessed. In particular, the reference case excludes the renewable energy and energy efficiency requirements under the 2006 Energy Independence Act (Initiative 937). The appendix concludes with a summary of key assumptions and results.

Electricity Trade and Allocation of GHG Emissions

Washington is part of the interconnected Western Electricity Coordinating Council (WECC) region - a vast and diverse area covering 1.8 million square miles and extending from Canada through Mexico, including all or portions of 14 western states. The inter-connected region allows electricity generators and consumers to buy and sell electricity across regions, taking advantage of the range of resources and markets. Electricity generated by any single plant enters the interconnected grid and may contribute to meeting demand throughout much of the region, depending on sufficient transmission capacity.

In 2006, 66 entities were involved in providing electricity to Washington customers. The State's three investor-owned utilities serve approximately 45% of the customers, and provide 36% of the electricity sales. The State's 18 electric cooperatives serve 5% of the customers and account for 4% of sales. One federal and 40 public utilities account for the remaining 50% of customers and almost 60% of sales. The top 5 providers of retail electricity in the State are reported in Table A1.

Table A1. Retail Electricity Providers in Washington (2006)

Entity	Ownership Type	2006 GWh
Puget Sound Energy Inc	Investor-Owned	21,092
Seattle City of	Public	9,455
PUD No 1 of Snohomish County	Public	6,483
Avista Corporation	Investor-Owned	5,411
Tacoma City of	Public	4,732
Total Sales, Top Five Providers		47,173
Total, All Washington		85,033

Source: EIA state electricity profiles

Since almost all states are part of regional trading grids, many states that have developed GHG inventories have grappled with the problem of how to account for electric sector emissions, when electricity flows across state borders. Several approaches have been developed to allocate GHG emissions from the electricity sector to individual states for inventories.

In many ways the simplest approach is *production-based* – emissions from power plants within the state are included in the state's inventory. The data for this estimate are publicly available and unambiguous. However, this approach is problematic for states that import or export significant amounts of electricity. Under a production-based approach, characteristics of Washington electricity consumption would not be fully captured since only emissions from in-state generation would be considered.

An alternative is to estimate *consumption-based* or *load-based* GHG emissions, corresponding to the emissions associated with electricity consumed in the state. The load-based approach is currently being considered by Washington and other Western states, such as California and

Oregon.¹⁸ By accounting for emissions from imported electricity, states can account for increases or decreases in fossil fuel consumed in power plants outside of the State, due to demand growth, efficiency programs, and other actions in the state. The difficulty with this approach is properly accounting for the emissions from imports and exports. To address this issue, Washington House Bill 2565 (Fuel Mix Disclosure Law) requires retail electricity suppliers in Washington to provide a disclosure label to their retail customers, at least semi-annually. This information has been collected and reported by the Department of Community, Trade, and Economic Development (CTED).

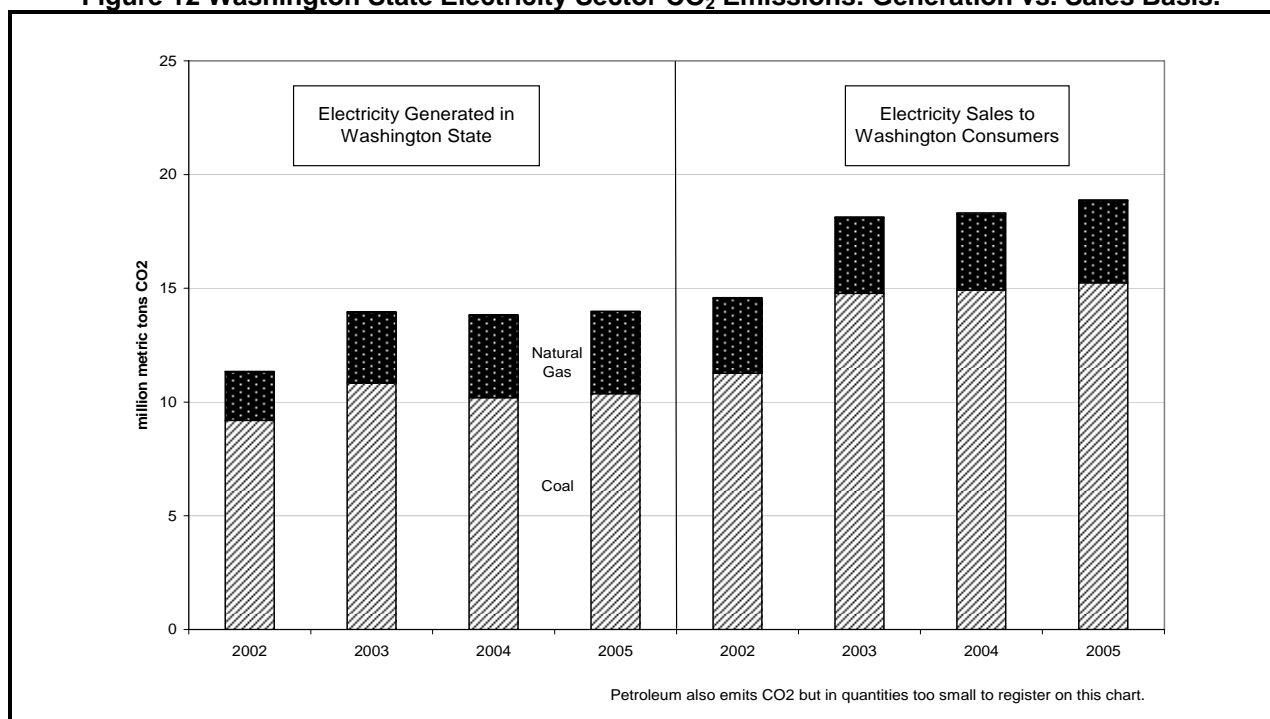
The report, *Washington's Greenhouse Gas Emissions: Sources and Trends*, (CTED December 2006)¹⁹ provides the following analysis:

Utilities can purchase or generate electricity from sources outside the state to serve their customers. Much of this out-of-state power is from fossil-based power plants, which impacts the emissions for Washington State associated with electricity consumption. Additionally, our hydro system is highly seasonal with much of the power being generated in the spring and early summer when the snow melts. Annually, Washington State is a net exporter of electricity but during the winter season, we rely on imports to meet our needs. Our excess electricity in the spring and summer is traded out of state in exchange for electricity that arrives when we need it most. However, this imported power is generally fossil and nuclear-based.

Beginning in 2000, Washington State began tracking the electricity sold to Washington consumers as a result the Fuel Mix Disclosure law. As shown in Figure 12 below, the data collected through this process allows us to compare the emissions from our electricity generation in Washington to the electricity generation that serves Washington consumers. It is apparent that some utilities in our state rely heavily on out-of-state fossil-based electricity generation to serve their customers and to balance seasonal electricity needs. Figure 12 reveals that CO₂ emissions associated with electric consumption are actually 30 percent higher than estimated using generation based data. Other states that have developed GHG inventories are also beginning to differentiate between CO₂ associated with in-state electricity generation and load based electricity sales.

¹⁸ See for example, the reports of the Puget Sound Climate Protection Advisory Committee (<http://www.pscleanair.org/specprog/globalclim/>), the Oregon Governor's Advisory Group On Global Warming (<http://egov.oregon.gov/ENERGY/GBLWRM/Strategy.shtml>), and the California Climate Change Advisory Committee, Policy Options for Reducing Greenhouse Gas Emissions From Power Imports - Draft Consultant Report (<http://www.energy.ca.gov/2005publications/CEC-600-2005-010/CEC-600-2005-010-D.PDF>).

¹⁹ Waterman-Hoey and Nothstein, Department of Community, Trade and Economic Development. December 2006

Figure 12 Washington State Electricity Sector CO₂ Emissions: Generation vs. Sales Basis.

The challenge for this analysis is extending the approach using the Fuel Mix Disclosure data to historic and future years, since the GHG emissions data are currently only available for 2002 through 2006. We applied the following simple approach:

- For 1990, CTED and Ecology recognized the need to estimate load-based GHG emissions for Washington electricity consumption. Staff reviewed public data on electricity sales and power plant ownership shares for each utility in the state. This information was combined with data on electricity generation and GHG emissions from power plants in the Northwest Power Pool to approximate the emissions associated with Washington's electricity consumption.²⁰ The value estimated by CTED/Ecology is used here.
- For historic years, 1991 – 1999, we interpolated the change in GHG emissions using total change between the estimated values for 1990 and 2000, with annual growth based on changes in production-based GHG emissions.
- For 2000-2002, GHG emissions were estimated based on electricity purchases from the Fuel Mix Disclosure data for these years and emission rates from the 2003 data.
- For future years, we assumed that the mix of resources supplying new electricity demand to Washington consumers would be similar to new electricity production in the entire Northwest Power Council region, as projected by the Northwest Power and

²⁰ <http://www.ecy.wa.gov/climatechange/docs/Updated1990GHGreport20071119.pdf>

Conservation Council.²¹ Based on this approach, new electricity demand in Washington for the period 2007-2020 is assumed to be supplied by a mix of electricity that is 22% coal, 46% natural gas, 26% wind and 6% biomass/geothermal/hydro. We do not estimate that location of this electricity generation; new coal could be provided by plants located outside of Washington.

The results section for this appendix reports both production-based and consumption-based GHG emissions for Washington for 1990 to 2020.

Electricity Generation – Washington’s Power Plants

The following section provides information on GHG emissions and other activity associated with power plants located in Washington. In other words, these are production-based emissions. While Washington is using a consumption-basis as the primary accounting approach for developing GHG emission targets and other key policies, the State and other states in the region are also tracking production-based emissions.

As displayed in Figure A1, hydro electric plants were used to generate the majority (over 70%) of Washington’s electricity in 2004, with natural gas, coal, biomass, and wind accounting for the remainder. Since hydro, biomass and wind generate no or very low GHG emissions and coal generation yields higher GHG emissions per MWh generated than natural gas, coal accounts for 74% of the GHG emissions from power plants in Washington.

We considered two sources of data in developing the historic inventory of GHG emissions from Washington power plants:

- EIA State Energy Data (SED), which must be multiplied by GHG emission factors for each type of fuel consumed.
- EPA data on CO₂ emissions by power plant.

To calculate total GHG emissions from electricity production in Washington, we applied SGIT emission factors to EIA’s SED. For CO₂ emissions from individual plants reported in Table A2, we used the EPA data.²² The GHG emissions from plants not listed individually in Table A2 is

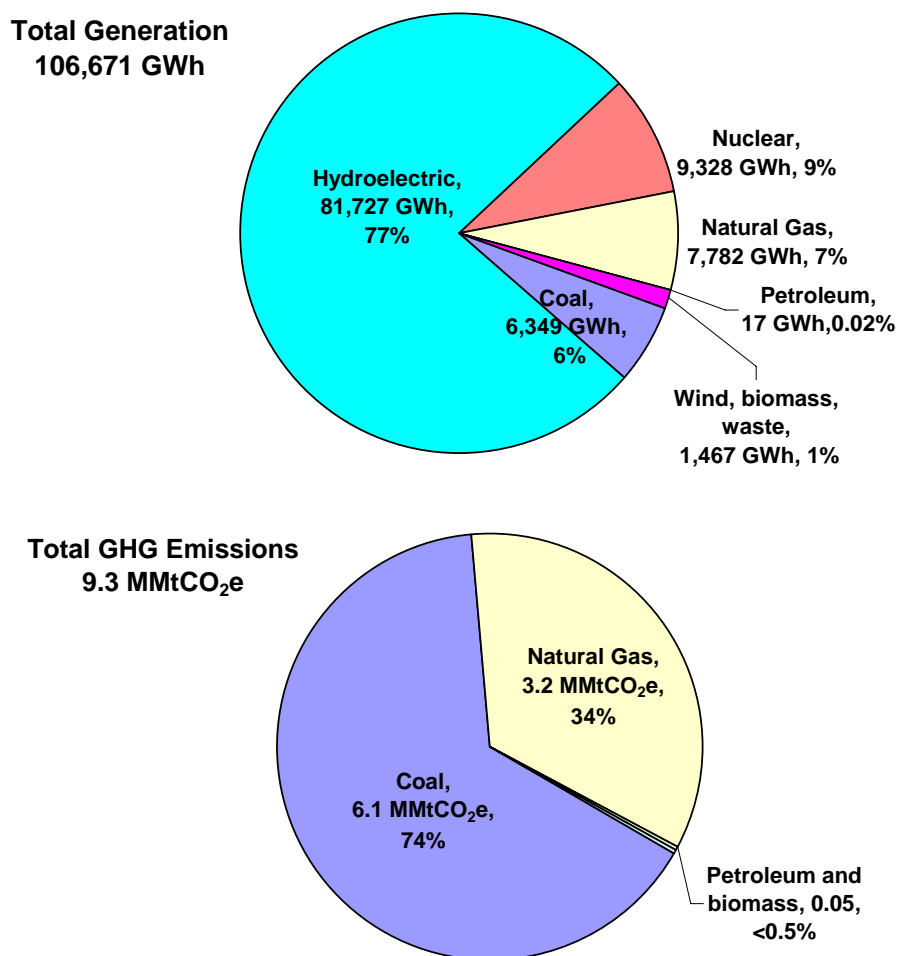
²¹ The reference case projections in this report are based on the ‘Utility Plans’ scenario of the report, Carbon Dioxide Footprint of the Northwest Power System (November 2007). <http://www.nwcouncil.org/library/2007/2007-15.htm>

²² For total electric sector GHG emissions, we used the EIA’s SED rather than EPA data because of comprehensiveness of the EIA-based data. The EPA data are limited to plants over 25 MW and only CO₂ emissions (EPA does not collect data on CH₄ or N₂O emissions). In addition, the EPA data currently excludes several key plants in Washington State, such as Encogen (160 MW), March Point (167 MW) and Tenaska (245 MW), capacity values from Northwest Power and Conservation Council, October 2006. *Power Plants in the Pacific Northwest* Excel spreadsheet downloaded from www.nwcouncil.org. Through discussions with EPA we also learned that EPA data tend to be conservative (i.e., overestimate emissions) because the data are reported as part of a regulatory program, and that during early years of the data collection program, missing data points were sometimes assigned a large value as a placeholder. However, EPA provides easily accessible data for each power plant (over 25 MW), which would be much more difficult to extract from EIA data and the CO₂ emissions from the two sources differ by less than 2% in most years. Based on this information, we chose to report both data sources in Table A2 but rely on the EIA data for the inventory values of total GHG emissions for this sector.

calculated as the difference between the total State CO₂ emissions based on EIA data and the reported CO₂ emissions for individual plants.

Table A2 reports the emissions from the five plants in Washington with the highest emissions from 2000 to 2005. The plant with the highest GHG emissions, Centralia, accounted for over 80% of Washington's GHG electricity-related emissions. TransAlta Corporation purchased Centralia in 2000 and added a 248 MW combined cycle gas turbine in 2002 to the existing 1340 MW of coal fired capacity.²³ The values reported in Table A2 for Centralia combine both coal and natural gas emissions. Electricity trade and GHG allocation are discussed in a following section.

Figure A1. Electricity Generation and CO₂ Emissions from Washington Power Plants, 2006



Note: Petroleum and biomass generation emitted 0.022 MMtCO₂e (0.16%) and 0.034 (0.25%) MMtCO₂e in 2004, respectively

²³ <http://www.power-technology.com/projects/centralia/>.

Table A2. CO₂ Emissions from Individual Washington Power Plants, 2000-2006

(Million metric tons CO ₂)	2000	2001	2002	2003	2004	2005	2006
<i>Centralia</i>	9.4	9.2	9.5	12.1	11.1	11.5	7.2
<i>Chehalis Generation Facility</i>	0.0	0.0	0.0	0.3	1.0	0.9	0.5
<i>Frederickson Power LP</i>	n/a	n/a	0.1	0.3	0.3	0.3	0.3
<i>Goldendale Energy Project</i>	0.0	0.0	0.0	0.0	0.1	0.4	0.4
<i>River Road</i>	0.7	0.7	0.6	0.6	0.7	0.6	0.5
<i>Other Plants</i>	3.8	3.8	1.1	0.5	0.4	0.2	0.3
Total CO₂ emissions	13.9	13.8	11.2	13.8	13.6	13.8	9.2

Source: U.S. EPA Clean Air Markets database for named plants (<http://camddataandmaps.epa.gov/gdm/index.cfm>). Total emissions calculated from fuel use data provided by SED (US DOE Energy Information Administration). Emissions from Other Plants is calculated as the difference between the Total Emissions and emissions reported from individual plants.

Table A3 shows the growth in generation by fuel type between 1990 and 2005. Overall generation grew by 0.5% over the 15 years. In Washington, natural gas generation has had particularly strong growth, growing from less than 0.1% of total generation to over 8.5% of generation in 2004. Hydro-electric generation is the dominant energy resource in the State. The table masks the year by year variation from hydro-electricity. In the 16 year period, hydro generation ranged from a low of 54,674 GWh in 2001 to a high of 103,875 GWh in 1997. Nuclear, biomass and wind generation all showed strong increases.

Table A3. Growth in Electricity Generation in Washington 1990-2005.

	Generation (GWh)	
	1990	2005
Coal	7,352	10,475
Hydroelectric	87,193	72,648
Natural Gas	24	8,468
Nuclear	5,742	8,242
Wind	0	401
biomass and waste	340	1,043
Petroleum	14	47
Total	100,664	101,325

Source: EIA Electric Power Annual Data, wind and biomass estimated from EIA Renewable Energy Annual

Electricity Consumption

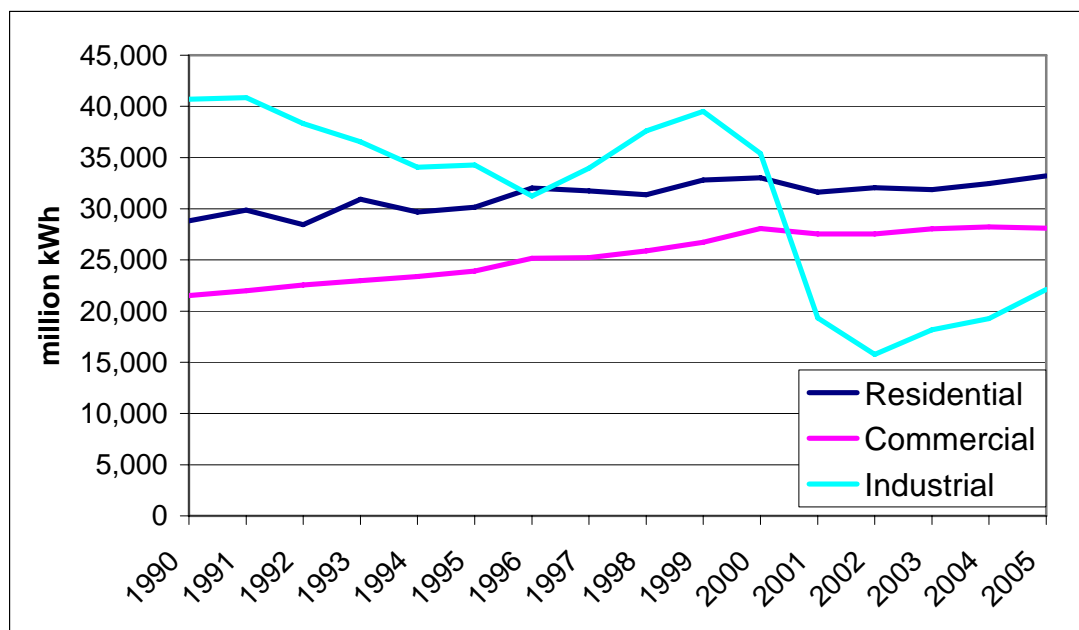
At about 13,000 kWh/capita (2004 data), Washington's electricity use per person is higher than the US average of 12,000 kWh per year.²⁴ Many components influence a state's per capita electricity consumption including weather (and subsequent demand for heating and cooling), the size and type of industries in the State, and the type and efficiency of equipment in the residential, commercial and industrial sectors.

As shown in Figure A2, electricity sales in the residential and commercial sectors grew moderately from 1990 to 2000 and have generally flattened since then. Industrial electricity sales in Washington fluctuated with decreases from 1990 through 1997 followed by increases to 2000.

²⁴ Census Bureau for U.S. population, Energy Information Administration for electricity sales.

Industrial sales experienced a large decrease in 2001, when during the electricity crunch, high electricity prices led to the closure of a number of aluminum plants.

Figure A2. Electricity Consumption by Sector in Washington, 1990-2005



Source: EIA State Energy Data (1990-2002) and EIA Electric Power Annual (2003-2005)

Future Electricity Consumption

Projections of electricity sales from 2006 through 2020 are based on an approximate average of projections by the 4 largest utilities in the State (Puget Sound Energy, City of Seattle, Snohomish County PUD, and Avista Corporation).²⁵ Although it would be preferable to combine projected growth rates from all utilities in the State, resources were not available to collect and integrate this information. The four largest utilities accounted for just over 50% of total sales in Washington in 2004. Table A4 reports both historic and projected annual average growth rates.

²⁵ Avista: [http://www.wutc.wa.gov/rms2.nsf/0/FF5F2D308EE7BB5488257149007B0CA3/\\$file/Avista+2005+electric+LCP+acknowledgement+letter+FINAL.doc](http://www.wutc.wa.gov/rms2.nsf/0/FF5F2D308EE7BB5488257149007B0CA3/$file/Avista+2005+electric+LCP+acknowledgement+letter+FINAL.doc), Puget Sound Energy: <http://www.pse.com/energyEnvironment/electricSupplyResPlanning.aspx>, City of Seattle: <http://www.seattle.gov/light/news/issues/irp/>, Snohomish: <http://www.snopud.com/Content/External/Documents/customerpubs/IRP04final.pdf>

Table A4. Electricity Growth Rates, historic and projected

	Historic		Projections	
	1990-2000	2000-2005	2005-2010	2010-2020
Residential	1.4%	0.1%	0.9%	0.9%
Commercial	2.7%	0.0%	2.3%	2.3%
Industrial	-1.4%	-9.0%	0.9%	0.9%
Total	0.6%	-2.9%	1.4%	1.3%

Source: Historic from EIA data, overall (total) projections from Integrated Resource Plans from (Puget Sound Energy, City of Seattle, Snohomish County PUD, and Avista Corporation). Sector breakdowns based on Puget Sound Energy projections.

Future Electricity Generation

Estimating future generation and GHG emissions from Washington power plants requires estimation of production levels from new and existing power plants. There are, of course, large uncertainties, especially related to the timing and nature of new power plant construction.

The different types of power plants that will operate in the future in Washington remains uncertain as the trends are influenced by many factors. Since 2000, new power plants in Washington have been mainly natural gas-fired with some wind and biomass. Most plants that are currently under construction or *planned*²⁶ are natural gas and wind. Several large natural gas plants have been proposed and Washington is also considering tidal energy. Table A5 presents data on new and proposed plants in Washington.

Individual proposed plants are not modeled in the reference case projections, but the mix of types of proposed plants are considered when developing assumptions.

²⁶ Planned refers to plants with a firm date for start of construction or for completion published; construction not underway

Table A5. New and Proposed Power Plants in Washington

	Plant Name	Fuel	Status or On-line date	Capacity MW	Illustrative generation GWh	Annual Emissions MMtCO ₂ e
Recent Plants	Big Hanaford	Natural gas	Aug-02	248.0	257	0.1
	Chehalis Generating Facility	Natural gas	Nov-03	520.0	1617	0.9
	Sierra Pacific Industries Aberdeen	Biomass	2003	18.0	132	0.0
	Frederickson Power 1	Natural gas	Aug-02	249.0	630	0.3
	Goldendale Energy Center	Natural gas	Sep-04	237.0	696	0.4
	Hopkins Ridge	Wind	Dec-05	150.0	460	0.0
	Nine Canyon Phase I & II	Wind	Sep-02 / Dec-03	63.7	147	0.0
	Pasco	Natural gas	Jul-02	43.0	57	0.0
	Big Horn	Wind	Dec-06	200	559	0.0
	Marengo I	Wind	Aug-07	140	394	0.0
	Wild Horse	Wind	Dec-06	229	701	0.0
Under Construction and Planned Plants	Mint Farm	Natural gas	Oct-07	286	2,255	0.8
	Goodnoe Hills East	Wind	Nov-07	94	267	0.0
	Nine Canyon Phase III	Wind	2007	32	91	0.0
	White Creek	Wind	2007	205	581	0.0
	Marengo II	Wind	Jun-08	70	199	0.0
	Wild Horse Solar	Solar	Dec-07	0.5	1.0	0.0
	Grays Harbor Energy Facility (Satsop) (Phase II)	Natural gas	2008	650.0	4,840	1.8
Permitted and Proposed plants	Agate Passage	Tidal current	Proposed	52.0	146	0.0
	BP Cherry Point Cogeneration Project	Natural gas	Proposed	720.0	5,361	2.0
	Kittitas Valley	Wind	Proposed	150.0	460	0.0
	Longview Power Station	Natural gas	Proposed	290.0	2,159	0.8
	Pacific Mountain Energy Center	Petroleum	Proposed	600.0	4,468	3.6
	Reardan Twin Buttes	Wind	Proposed	50.0	140	0.0
	Saddleback Mountain	Wind	Proposed	70.0	196	0.0
	San Juan Channel	Tidal current	Proposed	5.3	33	0.0
	Windy Point I & II	Wind	Permitted	242.5	744	0.0

Sources: Northwest Power and Conservation Council. October 2007. *Power Plant Development in the Pacific Northwest* Excel spreadsheet downloaded from www.nwccouncil.org. Illustrative Generation and emission estimates for new plants are based on 0.15 capacity factor for peaking plants, 0.85 for baseload, 0.35 for wind and 0.24 for solar. Generation estimates for *Recent Plants* are based on EIA data where available (all plants except Sierra Pacific biomass, Hopkins wind and Pasco natural gas – generation for these plants is estimated based on capacity factors listed for new plants).

Given the many factors impacting electricity related emissions and a diversity of assumptions by stakeholders within the electricity sector, developing a “reference case” projection for the most likely development of Washington’s electricity sector is particularly challenging. Therefore, to develop an initial projection, simple assumptions were made, relying to the extent possible on widely reviewed and accepted modeling assessments.

The reference case projections assume:

- Generation from power plants in Washington grows at 2.1% per year from 2006-2009, based on generation estimates from plants that are currently under construction (see table A5).
- Generation from power plants in Washington grows at 0.7% per year from 2010 to 2020. Overall average growth rate from 2006 to 2020 is 1.1% per year, just slightly lower than the rate assumed for electricity consumption in Washington.
- Generation from existing natural gas plants is based on holding generation at 2006 levels. Generation from existing hydro-electric plants is assumed to be 81,051 GWh per year, the average generation from the last ten years. Generation from existing coal plants is assumed to be 9,378 GWh, reflecting average generation over the period 2002 through 2006.
- New power plants built between now and 2009 are assumed to be the mix of resources indicated in Table A5, for ‘Under-construction and planned plants.’ Those plants built between 2010 and 2020 will be a mix of 68% natural gas, 27% wind, and 5% biomass / landfill gas or geothermal. This mix of proposed plants is based on regional projections from the Northwest Power Council, reflecting updated modeling of the 5th power plan.²⁷

As noted above, this reference case does not include the impact of recent policies and actions such as Initiative 937 (I-937) renewable and efficiency requirements.²⁸

Summary of Assumptions and Reference Case Projections

As noted, projecting generation sources, sales, and emissions for the electric sector out to 2020 requires a number of key assumptions:

- Economic and demographic activity.
- Changes in electricity-using technologies.
- Regional markets for electricity (and competitiveness of various technologies and locations).
- Access to transmission and distribution.
- The retirement of existing generation plants.

²⁷ Information provided by Jeff King (NWPCC) to Alison Bailie (CCS consultant) on July 20, 2007.

²⁸ In 2006, Washington voters approved Initiative 937 (I-937), a renewable energy standard. I-937 requires each utility with more than 25,000 customers to undertake cost-effective energy conservation and to obtain 3% of its load from new renewable resources by 2012. The required fraction of new renewable generation increases to 9% in 2016, and 15% in 2020, and every year thereafter.

- The response to changing fuel prices.
- The fuel/technology mix of new generation plants.

The key assumptions described above are summarized in Tables A6 and A7.

Table A6. Key Assumptions and Methods for Consumption (Load) Based Electricity Emissions Estimates

Electricity sales	Average annual growth of 1.4% from 2007 to 2010 and 1.3% from 2010 to 2020, based on growth rates reported by the 4 largest utilities.
Projected fuel mix	The mix of resources supplying new electricity demand to Washington consumers would be similar to new electricity production in the entire Northwest Power Council region, as projected by the Northwest Power and Conservation Council. Based on this approach, new electricity demand in Washington for the period 2007-2020 is assumed to be supplied by a mix of electricity that is 22% coal, 46% natural gas, 26% wind and 6% biomass/geothermal/hydro.
Transmission and Distribution losses	7% losses are assumed, based on regional losses projected by the AEO2006.

Table A7. Key Assumptions and Methods for Production Electricity Emissions Estimates (In-state generation)

Transmission and Distribution losses	Per above
In-state electricity generation	Average growth of 2.8% per year from 2005-2009 (based on plants under construction); 1.3% per year from 2010 to 2020, based on growth in electricity sales.
New Generation Sources (2006-2009)	The mix of new generation is based on plants under construction for this period (table A3).
New Generation Sources (2010-2020)	The mix of new non-renewable generation in this period is assumed to be 5% biomass, landfill gas or geothermal 27% wind 68% natural gas
Heat Rates	The assumed heat rate for new natural gas generation is 7000 Btu/kWh, based on estimates used in similar analyses. ²⁹
Operation of Existing Facilities	Existing natural gas facilities are assumed to continue to operate as at 2006 levels. Existing hydro facilities are assumed to generate 81,051 GWh per year, the average generation over the period 1996-2005. Generation from existing coal plants is assumed to be 9,378 GWh, reflecting average generation over the period 2002 through 2006.

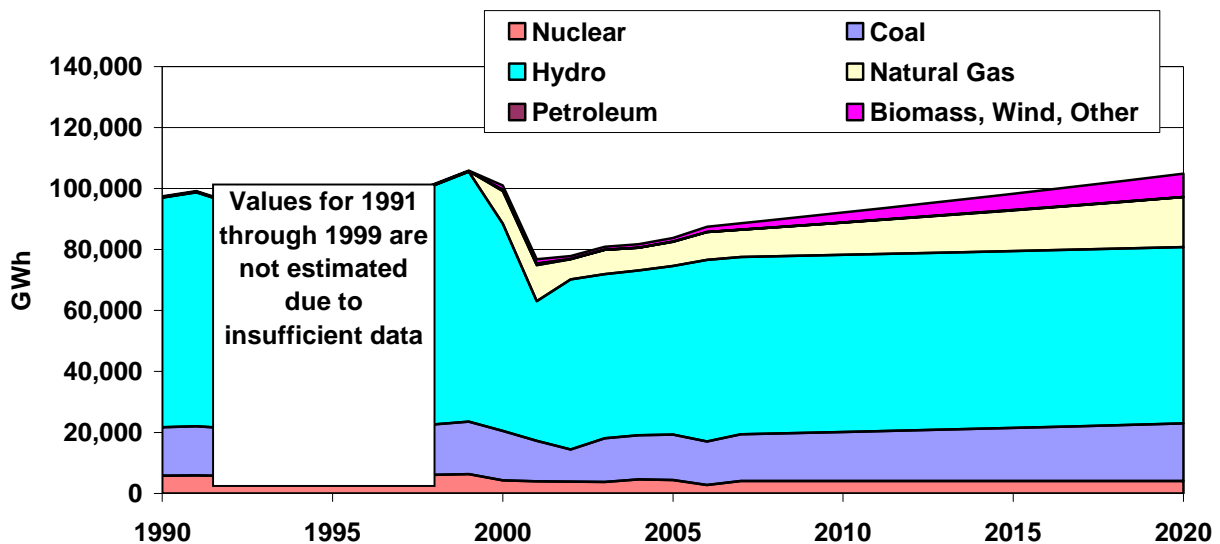
²⁹ See, for instance, the Oregon Governor's Advisory Group on Global Warming, <http://egov.oregon.gov/ENERGY/GBLWRM/Strategy.shtml>.

Results

Consumption (Load) -based results

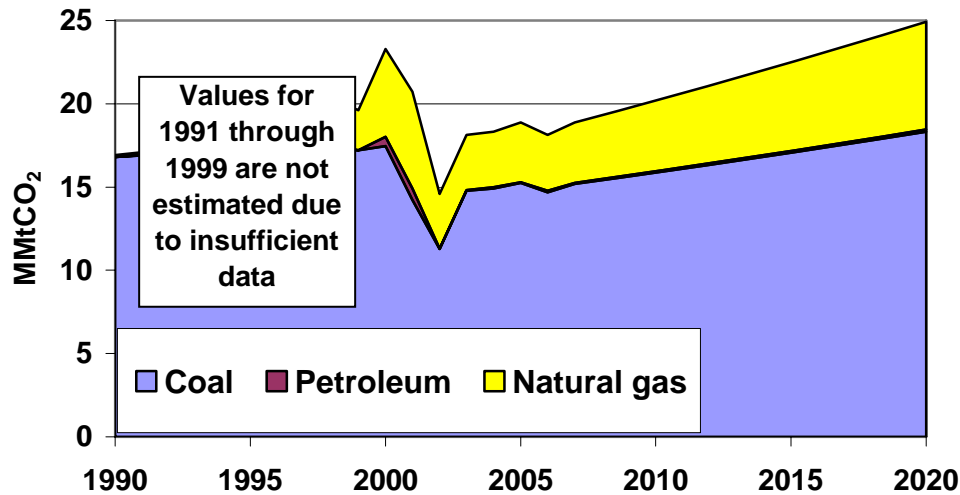
Figure A3 shows the estimated sources of electricity generated to supply Washington's electricity load by fuel source, along with projections to the year 2020 based on the assumptions described above. The estimated generation for 1990 and 2000 – 2006 has been calculated by CTED. Estimates for electricity generation on a load-basis for 1991 through 1999 are not currently available. For future years, overall electricity demand is projected to grow at an average of 1.3% per year from 2006 to 2020. As described above, we estimate that this demand will be met by a mix of fossil and renewable resources. Non-hydro renewable generation shows strong growth, from approximately 1,600 GWh in 2006 to over 7,500 GWh in 2020, with almost 5,500 GWh from wind. Natural gas generation is projected to increase by 80% from 2006 to 2020.

Figure A3. Electricity Generated to meet Washington's Electricity Demand 1990-2020



Source: 1990 & 2000-2006 CTED estimates, 2007-2020 calculations based on assumptions described above, generation from petroleum resources is too small to be visible in the chart

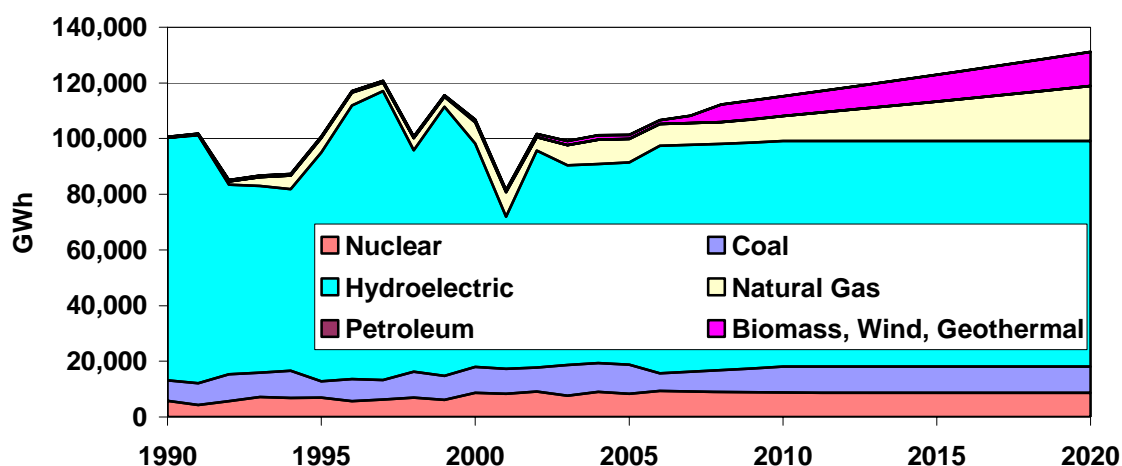
Figure A4 shows GHG emissions associated with Washington's electricity demand, using the consumption basis derived from the Fuel Mix Disclosure data as described above. This reflects the data indicating imports of coal-based electricity and assumptions that Washington will continue to import some of its electricity from coal or other fossil fuel-based resources, while exporting electricity from hydro or other low GHG emitting resources. The large increase in emissions in 2000 and 2001 reflect high levels of electricity imports from coal and other fossil fuel-based sources. In 2002, emissions dropped due to both greater in-state hydro generation and lower in-state electricity sales. Consumption-based emissions for the State increase by 1.9% per year from 2005 to 2020.

Figure A4. Washington GHG Emissions Associated with Electricity Use (Consumption-Basis)

Source: 1990 & 2000-2006 CTED estimates, 2007-2020 calculations based on assumptions described above

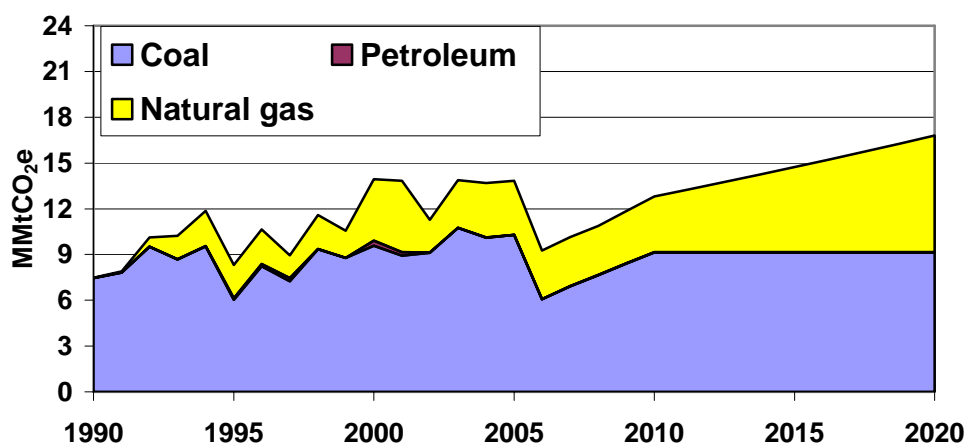
Production-based results

Figure A5 shows historical sources of electricity generation in the state by fuel source, along with projections to the year 2020 based on the assumptions described above. Overall electricity generation grows at 1.1% per year from 2006 to 2020. Renewables (biomass and wind) and natural gas generation show strong growth, relative to 2005 levels. Wind generation is projected to grow from approximately 500 GWh per year currently to just over 5,500 GWh in 2020, with much of the growth occurring in the next three years as Big Horn, Wild Horse, Marengo and other plants already under construction come on-line. Natural gas generation in Washington state is projected to double from 2006 to 2020.

Figure A5. Electricity Generated by Washington Power Plants 1990-2020

Source: 1990-2005 EIA data, 2006-2020 Calculations based on assumptions described above, generation from petroleum resources is too small to be visible in the chart

Figure A6 illustrates the GHG emissions associated with the mix of electricity generation shown in Figure A5 (production-based emissions). From 2005 to 2020, the emissions from Washington electricity generation are projected to grow at 1.3% per year with most of the projected growth occurring after 2010. Prior to 2010, the mix of new plants is dominated by the wind plants currently under construction. The GHG emission intensity (emissions per MWh) of Washington electricity generation is projected to decrease from 0.14 MtCO₂/MWh in 2005 to 0.11 in 2010 then increasing to 0.13 MtCO₂/MWh in 2020.

Figure A6. Washington GHG Emissions Associated with Electricity Production (Production-Basis)

Source: Calculations based on approach described in text.

Summary of Results

Table A8 summarizes the GHG emissions for Washington's electric sector from 1990 to 2020. During this time period, emissions are projected to increase by almost 50% on a consumption-basis and more than double on a production-basis.

Table A8. Washington GHG Emissions from Electric Sector, Production and Consumption-based estimates, 1990-2020.

(Million Metric Tons CO ₂ e)	1990	2000	2005	2010	2020
Electricity, Consumption-based	16.9	23.3	18.9	20.2	24.9
Coal	16.8	17.4	15.2	15.9	18.3
Natural Gas	0.0	0.6	0.0	0.1	0.1
Petroleum	0.1	5.3	3.6	4.3	6.5
Biomass and Waste (CH ₄ and N ₂ O)	0.0	0.0	0.0	0.0	0.0
Electricity, Production-based	7.5	13.9	13.8	13.7	15.9
Coal	7.4	9.6	10.3	9.1	9.1
Natural Gas	0.0	4.0	3.6	4.6	6.8
Petroleum	0.0	0.3	0.0	0.0	0.0
Biomass and Waste (CH ₄ and N ₂ O)	0.0	0.0	0.0	0.0	0.0

Note: Values that are less than 0.005 MMTCO₂e are listed as 0.0 in table A8.

Key Uncertainties

Key sources of uncertainty underlying the estimates above are as follows:

- Future projections for electricity consumption and mix of new generation. In particular, coal plants that could be built in Washington State to meet out-of-state electricity needs are not included in this analysis and could lead to large increases in GHG emissions.
- Future generation from existing hydro-electric plants. Generation levels have fluctuated significantly in the last 15 years and future generation is dependent on uncertain weather-related factors.

We have also identified the following uncertainties with the FMD data used to estimate consumption-based emissions for 2000-2006:

- Utility Fuel mix reporting is not reviewed or verified and reporting requirements are less rigorous than the Energy Information Administration standards.
- GHG emission estimates for electricity generated outside the North West Power Pool could be refined further.

Appendix B. Residential, Commercial, and Industrial (RCI) Fossil Fuel Combustion

Overview

Activities in the RCI³⁰ sectors produce carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O) emissions when fuels are combusted to provide space heating, process heating, and other applications. Carbon dioxide accounts for over 98% of these emissions in Washington on a million metric tons (MMt) of CO₂ equivalent (CO₂e) basis. In addition, since these sectors consume electricity, one can also attribute emissions associated with electricity generation to these sectors in proportion to their electricity use.³¹ If emissions from the generation of the electricity they consume are not included, the RCI sectors are between them the second largest source of gross greenhouse gas (GHG) emissions in Washington. Direct use of oil, natural gas, coal, and wood in the RCI sectors accounted for an estimated 19.4 MMtCO₂e (20%) of gross GHG emissions in 2005.³²

Data Sources and Approach

Emissions for direct fuel use were estimated, in this inventory and forecast prepared for the Washington Climate Advisory Team (CAT), using the United States Environmental Protection Agency's (US EPA) State Greenhouse Gas Inventory Tool (SGIT) software and the methods provided in the Emission Inventory Improvement Program (EIIP) guidance document for RCI fossil fuel combustion.³³ The default data used in SGIT for Washington are from the United States Department of Energy (US DOE) Energy Information Administration's (EIA) *State Energy Data* (SED). The SGIT default data for Washington were revised using the most recent data available, which includes: (1) 2002 SED information for all fuel types;³⁴ (2) 2003 SED information for coal, and wood and wood waste;³⁵ (3) 2003 and 2004 SED information for natural gas and petroleum (distillate oil, kerosene and liquefied petroleum gas) consumption (same data source as previous citation); (4) 2004 electricity consumption data from the EIA's

³⁰ The industrial sector includes emissions associated with agricultural energy use and fuel used by the fossil fuel production industry.

³¹ Emissions associated with the electricity supply sector (presented in Appendix A) have been allocated to each of the RCI sectors for comparison of those emissions to the fuel-consumption-based emissions presented in Appendix B. Note that this comparison is provided for information purposes and that emissions estimated for the electricity supply sector are not double-counted in the total emissions for the state. One could similarly allocate GHG emissions from natural gas transmission and distribution, other fuels production, and transport-related GHG sources to the RCI sectors based on their direct use of gas and other fuels, but we have not done so here due to the difficulty of ascribing these emissions to particular end-users. Estimates of emissions associated with the transportation sector are provided in Appendix C, and estimates of emissions associated with fossil fuel production and distribution are provided in Appendix E.

³² Emissions estimates from wood combustion include only N₂O and CH₄. Carbon dioxide emissions from biomass combustion are assumed to be "net zero", consistent with US EPA and IPCC methodologies, and any net loss of carbon stocks due to biomass fuel use should be accounted for in the land use and forestry analysis.

³³ GHG emissions were calculated using SGIT, with reference to *EIIP, Volume VIII*: Chapter 1 "Methods for Estimating Carbon Dioxide Emissions from Combustion of Fossil Fuels", August 2004; and Chapter 2 "Methods for Estimating Methane and Nitrous Oxide Emissions from Stationary Combustion", August 2004.

³⁴ EIA *State Energy Data 2002*, Data through 2002, released June 30, 2006, (http://www.eia.doe.gov/emeu/states/state.html?q_state_a=co&q_state=WASHINGTON).

³⁵ EIA *State Energy Data 2003 revisions for all fuels and first release of 2004 information for natural gas and petroleum*, (http://www.eia.doe.gov/emeu/states/seds_updates.html).

State Electricity Profiles;³⁶ and (5) 2005 natural gas consumption data from the EIA's *Natural Gas Navigator*.³⁷ The inventory described in this appendix reflects estimated 2004 coal consumption for all three of the RCI sectors as prepared by the Washington Department of CTED (see reference below). The Washington Department of CTED also accounted for a significant portion of industrial petroleum coke consumption by primary aluminum manufacturing under the industrial processes non-fuel use category (see Appendix D), therefore, the petroleum coke consumption data for the industrial fuel use sector described in this Appendix B were adjusted to eliminate double counting of emissions associated with petroleum coke consumption in Washington.

The Washington Department of Community, Trade, and Economic Development (CTED) prepared a GHG inventory for the RCI sectors using the default SED information³⁸. For the inventory described in this Appendix B, the SED information used is essentially the same as that used by CTED, with the exception that the Center for Climate Strategies (CCS) updated SED information for 2004 and 2005 published by the EIA after CTED completed its inventory. In addition, CTED inventory for residential wood consumption contained SED data through 2001; since SED information was available through 2003, SED residential wood consumption values for 2001 through 2003 were included in the inventory described in this appendix.

Note that the EIIP methods for the industrial sector exclude from CO₂ emission estimates the amount of carbon that is stored in products produced from fossil fuel feedstocks not used to provide energy. For example, the methods account for carbon stored in petrochemical feedstocks, and liquefied petroleum gases (LPG) and natural gas used as feedstocks by chemical manufacturing plants (i.e., not used as fuel), as well as carbon stored in asphalt and road oil produced from petroleum. The carbon storage assumptions for these products are explained in detail in the EIIP guidance document.³⁹ The fossil fuel categories for which the EIIP methods are applied in the SGIT software to account for carbon storage include the following categories: asphalt and road oil, coking coal, distillate fuel, feedstocks (naphtha with a boiling range of less than 401 degrees Fahrenheit), feedstocks (other oils with boiling ranges greater than 401 degrees Fahrenheit), LPG, lubricants, miscellaneous petroleum products, natural gas, pentanes plus,⁴⁰ petroleum coke, residual fuel, still gas, and waxes. Data on annual consumption of the fuels in these categories as chemical industry feedstocks were obtained from the EIA SED.

Reference case emissions from direct fuel combustion were estimated based on fuel consumption forecasts from EIA's *Annual Energy Outlook 2006* (AEO2006),⁴¹ with adjustments for

³⁶ EIA *Electric Power Annual 2005 - State Data Tables*, (http://www.eia.doe.gov/cneaf/electricity/epa/epa_sprdshts.html).

³⁷ EIA *Natural Gas Navigator* (http://tonto.eia.doe.gov/dnav/ng/ng_cons_sum_dcu_SWA_a.htm).

³⁸ *Washington's Greenhouse Gas Emissions: Sources and Trends*, by Stacey Waterman-Hoey and Greg Nothstein, WA State Dept. of Community, Trade & Economic Development, Energy Policy Division, dated December 2006 (Revised 2/12/07), and available from http://www.cted.wa.gov/portal/alias_CTED/lang_en/tabID_853/DesktopDefault.aspx.

³⁹ EIIP, Volume VIII: Chapter 1 "Methods for Estimating Carbon Dioxide Emissions from Combustion of Fossil Fuels", August 2004.

⁴⁰ A mixture of hydrocarbons, mostly pentanes and heavier fractions, extracted from natural gas.

⁴¹ EIA AEO2006 with Projections to 2030, (<http://www.eia.doe.gov/oiaf/aeo/index.html>).

Washington's projected population⁴² and employment growth. Washington employment data for the manufacturing (goods producing) and non-manufacturing (commercial or services providing) sectors were obtained from the Washington State Employment Security Department.⁴³ Regional employment data for the same sectors were obtained from EIA for the EIA's Pacific region.⁴⁴ Table B1 shows historic and projected growth rates for electricity sales by sector. Table B2 shows historic and projected growth rates for energy use by sector and fuel type. For the residential sector, the rate of population growth is expected to average about 1.5% annually between 2004 and 2020; this demographic trend is reflected in the growth rates for residential fuel consumption. Based on the Washington State Employment Security Development's forecast (2004 to 2014), commercial and industrial employment are projected to increase at compound annual rates of 0.93% and 1.07%, respectively, and these growth rates are reflected in the growth rates in energy use shown in Table B2 for the two sectors. These estimates of growth relative to population and employment reflect expected responses of the economy — as simulated by the EIA's National Energy Modeling System — to changing fuel and electricity prices and changing technologies, as well as to structural changes within each sector (such as shifts in subsectoral shares and in energy use patterns).

Table B1. Electricity Sales Annual Growth Rates, Historical and Projected

Sector	1990-2004*	2005-2010**	2010-2020**
Residential	0.9%	0.9%	0.9%
Commercial	2.0%	2.3%	2.3%
Industrial	-5.2%	0.9%	0.9%
Total	-0.9%	1.4%	1.3%

* 1990-2004 compound annual growth rates calculated from Washington electricity sales by year from EIA state electricity profiles (Table 8), (http://www.eia.doe.gov/cneaf/electricity/st_profiles/e_profiles_sum.html).

** Compound annual growth rates for 2005-2010 and 2010-2020 for total consumption and for each of the three sectors were taken from the forecast for the energy supply sector (see Appendix A).

Results

Figures B1, B2, and B3 show historical and projected emissions for the RCI sectors in Washington from 1990 through 2020. These figures show the emissions associated with the direct consumption of fossil fuels and, for comparison purposes, show the share of emissions associated with the generation of electricity consumed by each sector. The residential sector's share of total RCI emissions from direct fuel use and electricity use was 23% in 1990, increased to a high of 33% in 2005, and is projected to decline to 30% by 2020. The commercial sector's share of total RCI emissions from direct fuel use and electricity use was 19% in 1990, increased to 24% in 2005, and is projected to increase slightly more to 25% by 2020. The industrial sector's share of total RCI emissions from direct fuel use and electricity use was 58% in 1990, declined to a low of 43% in 2005, and is projected to increase slightly to 45% by 2020.

⁴² Population data from the State of Washington, Office of Financial Management, Forecast of the State Population, November 2006 Release (<http://www.ofm.wa.gov/pop/stfc/default.asp>).

⁴³ Washington State Employment Security Department, Labor Market and Economic Analysis, Workforce Employer, Publications and Reports, Located under "Projections / Long-term Employment Projections," Excel File Name = 5004_indlongp.xls, Excel file title = Annual Average Nonagricultural Wage and Salary Employment, Estimated 2004 and Projected 2009 and 2014, Washington State (in thousands), June 2006 (<http://www.workforceexplorer.com/cgi/dataanalysis/?PAGEID=94&SUBID=149>).

⁴⁴ AEO2006 employment projections for EIA's Pacific region obtained through special request from EIA (dated September 27, 2006).

Emissions associated with the generation of electricity to meet RCI demand from 1990 through 2020 accounts for about, on average, 48% of the emissions for the residential sector, 56% of the emissions for the commercial sector, and 23% of the emissions for the industrial sector. Natural gas consumption is the next-highest source of emissions for all three sectors, accounting for about 38% of total emissions in the residential sector, 35% for the commercial sector, and 27% for the industrial sector when averaged over the 1990 to 2020 period.

Table B2. Historic and Projected Average Annual Growth in Energy Use in Washington, by Sector and Fuel, 1990-2020

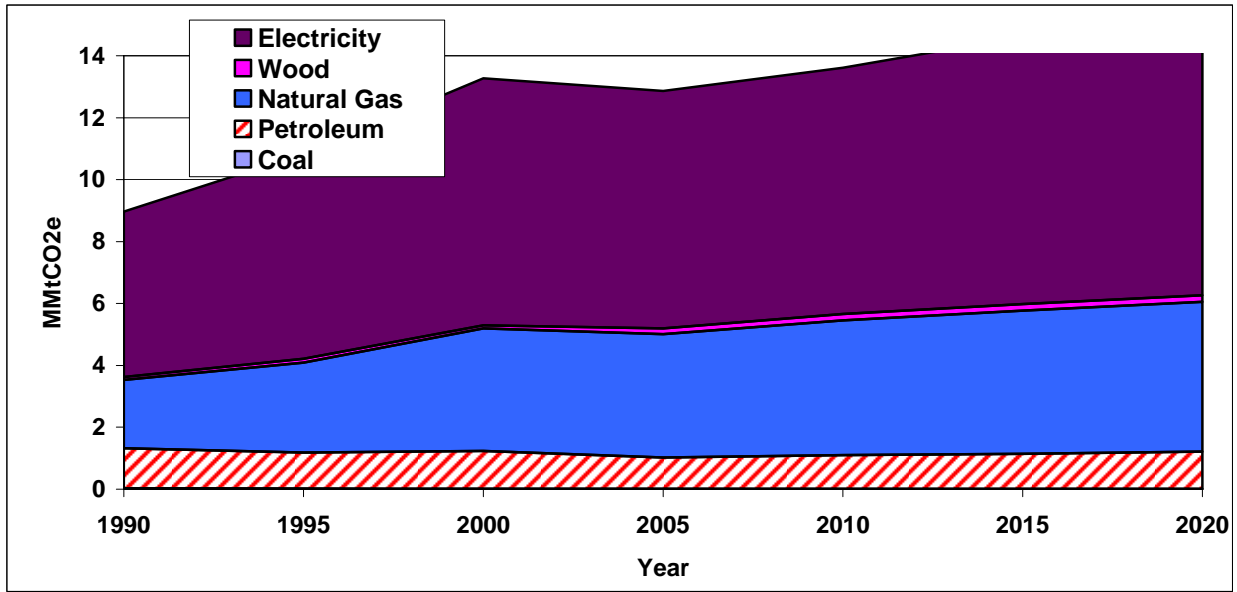
	1990-2004*	2005-2010**	2010-2015**	2015-2020**
Residential				
natural gas	4.0%	1.9%	1.3%	1.0%
petroleum	-1.5%	1.7%	0.3%	2.0%
wood	5.1%	1.8%	0.5%	0.6%
coal	-9.6%	1.7%	-0.3%	-0.5%
Commercial				
natural gas	1.7%	-0.4%	1.7%	1.0%
petroleum	-5.1%	-1.0%	0.5%	0.0%
wood	9.0%	-0.6%	-0.1%	-0.5%
coal	-6.2%	-0.7%	-0.1%	-0.5%
Industrial				
natural gas	-1.1%	1.5%	2.1%	2.4%
petroleum	-6.2%	3.4%	1.8%	1.2%
wood	-2.6%	3.6%	2.8%	2.7%
coal	-6.5%	2.5%	0.5%	1.1%

* Compound annual growth rates calculated from EIA SED historical consumption by sector and fuel type for Washington. Latest year for which EIA SED information was available for each fuel type is 2003 for coal and wood/wood waste, 2004 for petroleum, and 2005 for natural gas. Petroleum includes distillate fuel, kerosene, and liquefied petroleum gases for all sectors plus residual oil for the commercial and industrial sectors. The Washington Department of CTED, in its GHG inventory, estimated 2004 coal consumption for all three sectors, and accounted for a significant portion of industrial petroleum coke consumption by primary aluminum manufacturing under the industrial processes non-fuel use category (see Appendix D).

** Figures for growth periods starting after 2004 are calculated from AEO2006 projections for EIA's Pacific region, adjusted for Washington's projected population for the residential sector, non-manufacturing employment for the commercial sector, and manufacturing employment for the industrial sector.

For the residential sector, emissions from electricity and direct fossil fuel use in 1990 were about 9.0 MMtCO₂e, and are estimated to increase to about 15.6 MMtCO₂e by 2020. Emissions associated with the generation of electricity to meet residential energy consumption demand account for about 60% of total residential emissions. In 1990, natural gas consumption accounted for about 25% of total residential emissions and is estimated to account for about 31% of total residential emissions by 2020. Residential-sector emissions associated with the use of petroleum accounted for about 14% of total residential emissions in 1990 and are estimated to decline to 8% of total residential emissions by 2020. Residential-sector emissions associated with the use of coal and wood in 1990 were about 0.12 MMtCO₂e combined, and accounted for about 1% of total residential emissions. By 2020, emissions associated with the consumption of these two fuels are estimated to be 0.22 MMtCO₂e and to account for 1% of total residential sector emissions by that time.

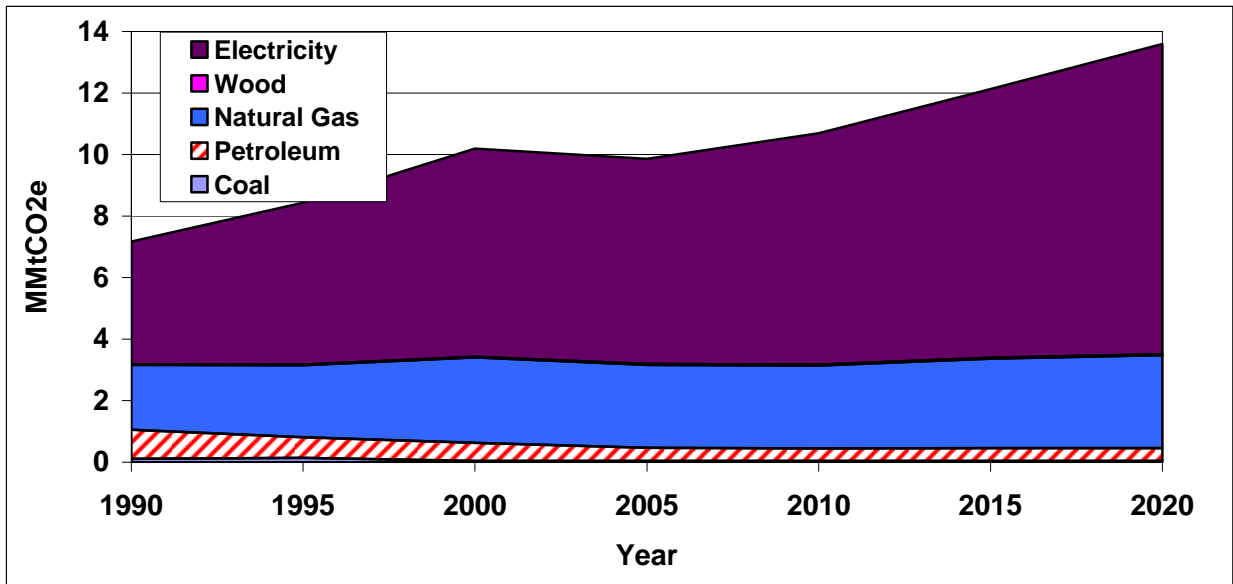
Figure B1. Residential Sector GHG Emissions from Fuel Consumption



Source: Calculations based on approach described in text.

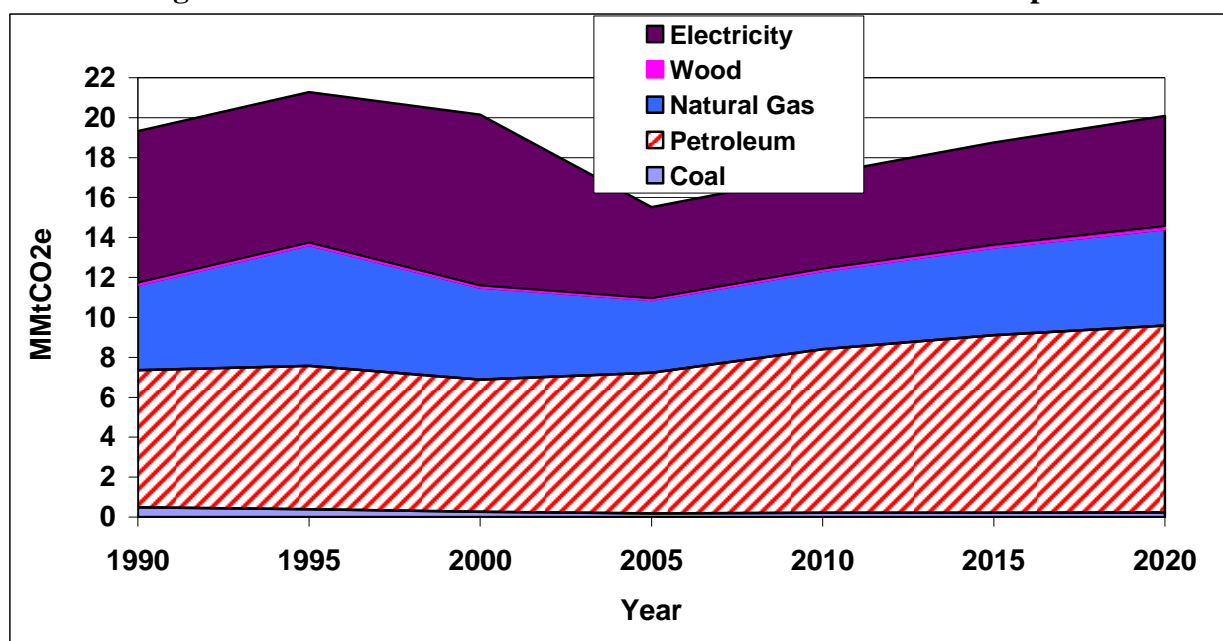
Note: Emissions associated with coal combustion are too small to be seen on this graph.

Figure B2. Commercial Sector GHG Emissions from Fuel Consumption



Source: CCS calculations based on approach described in text.

Note: Emissions associated with coal combustion are too small to be seen on this graph.

Figure B3. Industrial Sector GHG Emissions from Fuel Consumption

Source: CCS calculations based on approach described in text.

For the 15-year period 2005 to 2020, residential-sector GHG emissions associated with the use of electricity, natural gas, and petroleum are expected to increase at average annual rates of about 1.3%, 1.3%, and 1.2%, respectively. Emissions associated with the use of coal and wood are expected to increase annually by about 0.2% and 0.9%, respectively. Total GHG emissions for this sector increase by an average of about 1.3% annually over the 15-year period.

Residential wood consumption increased by over 58% from between 2000 and 2001, and increased by about 68% from 2000 through 2003. According to a contact with the Washington Department of CTED, this increase is most likely associated with households switching to using wood for home heating due to increases in electricity prices during this time period.

For the commercial sector, emissions from electricity and direct fuel use in 1990 were about 7.2 MMtCO₂e and are estimated to increase to about 13.6 MMtCO₂e by 2020. Emissions associated with the generation of electricity to meet commercial demand accounted for about 56% of total commercial emissions in 1990, and are estimated to increase to about 74% of total commercial emissions by 2020, as use of electricity in this sector grows much more rapidly than use of other fuels. In 1990, natural gas consumption accounted for about 29% of total commercial emissions, and is estimated to account for about 22% of total commercial emissions by 2020. Commercial-sector emissions associated with the use of petroleum accounted for about 13% of total commercial emissions in 1990, and are projected to decline to about 3% of total commercial emissions by 2020. Commercial-sector emissions associated with the use of coal accounted for about 1.5% of total commercial emissions in 1990, and are estimated to decline to about 0.3% of total commercial emissions by 2020. Commercial-sector emissions associated with the use of wood accounted for about 0.15% of total commercial emissions in 1990, and are projected to increase slightly to account for 0.22% of total commercial emissions by 2020.

For the 15-year period 2005 to 2020, commercial-sector GHG emissions associated with the use of electricity and natural gas are expected to increase at average annual rates of about 2.8% and 0.8%, respectively. Emissions associated with the use of petroleum, coal, and wood are expected to decline at average annual rates of about 0.2%, 0.5%, and 0.4%, respectively. Total GHG emissions for this sector increase at an average of about 2.2% annually over the 15-year period.

For the industrial sector, emissions in 1990 were about 19 MMtCO₂e, and are estimated to increase to about 20 MMtCO₂e by 2020. Emissions associated with the generation of electricity to meet industrial demand accounted for about 39% of total industrial emissions in 1990 and are estimated to decline to about 27% of total industrial emissions by 2020. In 1990, natural gas consumption accounted for about 22% of total industrial emissions, and this fraction is estimated to increase slightly, to about 24% of total industrial emissions by 2020. Industrial-sector emissions associated with the use of petroleum accounted for about 36% of total industrial emissions in 1990, and are projected increase to about 47% of total industrial emissions by 2020. Industrial-sector emissions associated with the use of coal accounted for about 2.5% of total industrial emissions in 1990, and are estimated to decline to about 1.1% of total industrial emissions by 2020. Industrial-sector emissions associated with the use of wood accounted for about 1% of total industrial emissions in 1990, and are projected to continue to account for about 1% of total industrial emissions through 2020.

For the 15-year period 2005 to 2020, industrial sector GHG emissions associated with the use of electricity, natural gas, and petroleum are expected to increase at average annual rates of about 1.2%, 1.9%, and 1.9%, respectively. Emissions associated with the use of coal and wood are expected to increase annually by about 1.2% and 2.9%, respectively. Total GHG emissions for this sector increase by an average of about 1.7% annually over the 15-year period.

Figures B1 and B2 show substantial increases from 1990 through 2000 in GHG emissions associated with the generation of electricity for the residential and commercial sectors, respectively. These increases are associated with an increase in the use of coal and natural gas (as opposed to hydro power, which has historically supplied much of the Northwest's power) for generation to meet the residential and commercial sectors' increased demand for electricity over this period. As a consequence, the increases in residential and industrial emissions associated with electricity use are a composite of growth in electricity use by those sectors, and an increase in the average emission factor for GHG emissions per unit of electricity generated (and consumed). Figure B3 shows a decline in GHG emissions for the industrial sector from 2000 to 2005, corresponding to a large decrease in industrial electricity consumption beginning in 2001, when during a period of rapidly rising rates for electricity, high electricity prices led to the closure of a number of aluminum plants.

Key Uncertainties

Key sources of uncertainty underlying the estimates above are as follows:

- Population and economic growth are the principal drivers for electricity and fuel use. The reference case projections are based on regional fuel consumption projections for EIA's Pacific modeling region scaled for Washington population and employment growth projections. Consequently, there are significant uncertainties associated with the projections. Future work should attempt to base projections of GHG emissions on fuel

consumption estimates specific to Washington to the extent that such data become available.

- The AEO2006 projections that underlie much of the reference case projection presented here assume no large long-term changes in relative fuel and electricity prices, relative to current price levels and to US DOE projections for fuel prices. Price changes would influence consumption levels and, to the extent that price trends for competing fuels differ, may encourage switching among fuels.
- For CH₄ and N₂O, to convert tons of gas emitted to CO₂-equivalents, the Washington Department of CTED used the 100-year global warming potentials published by the Intergovernmental Panel on Climate Change (IPCC) in their Third Assessment Report (TAR, IPCC 2001).⁴⁵ For the inventory described in this appendix, the US EPA SGIT was used to calculate CH₄ and N₂O for the RCI sectors. The SGIT tool uses the global warming potential values that the IPCC published in their Second Assessment Report (SAR)⁴⁶ in order to be consistent with the US EPA National GHG inventory. Thus, the emissions for CH₄ and N₂O on a CO₂-equivalent basis will differ slightly from the emissions calculated by the Washington Department of CTED. The following compares the global warming potential factors in the IPCC SAR and TAR:

Gas	SAR	TAR
CO ₂	1	1
CH ₄	21	23
N ₂ O	310	296

⁴⁵ IPCC (2001) *Climate Change 2001: A Scientific Basis*, Intergovernmental Panel on Climate Change; J.T. Houghton, Y. Ding, D.J. Griggs, M. Noguer, P.J. van der Linden, X. Dai, C.A. Johnson, and K. Maskell, eds.; Cambridge University Press. Cambridge, U.K.

⁴⁶ IPCC (1996) *Climate Change 1995: The Science of Climate Change*. Intergovernmental Panel on Climate Change; J.T. Houghton, L.G. Meira Filho, B.A. Callander, N. Harris, A. Kattenberg, and K. Maskell, eds.; Cambridge University Press. Cambridge, U.K.

Appendix C. Transportation Energy Use

Overview

Transportation is one the largest GHG source sectors in Washington. The transportation sector includes light and heavy-duty (on-road) vehicles, aircraft, rail engines, and marine engines. Carbon dioxide accounts for about 98 percent of transportation GHG emissions from fuel use. Most of the remaining GHG emissions from the transportation sector are due to N₂O emissions from gasoline engines.

Inclusion of Maritime Transportation

Several options exist for estimating transportation GHG emissions in Washington State. One fundamental question is whether to include GHG emissions from marine transportation. The analysis here includes an estimate of marine fuel consumption, and resulting emissions, based on analyses by local air agencies. The CTED report, *Washington's Greenhouse Gas Emissions: Sources and Trends* (2006) excludes emissions from residual fuel consumption in the transportation sector following an inventory agreement between the West Coast States. The Puget Sound Maritime Air Forum has recently completed a study on emissions from maritime-related diesel equipment operating within the greater Puget Sound region, and this data has been incorporated into the inventory.⁴⁷

Data Sources and Approach

GHG emissions for 1990 through 2005 come from a combination of the report, *Washington's Greenhouse Gas Emissions: Sources and Trends*, (CTED December 2006)⁴⁸ and using SGIT and the methods provided in the EIIP guidance document for the sector.^{49,50} For on-road vehicles, the CO₂ emission factors are in units of lb/MMBtu and the CH₄ and N₂O emission factors are both in units of grams/VMT. Key assumptions in this analysis are listed in Table C1. The default fuel consumption data within SGIT were used to estimate emissions, with the most recently available fuel consumption data (2005) from EIA SED added.⁵¹ The one exception is motor gasoline consumption from 1996 to 2005. For this data, the analysis follows the approach taken by *Washington's Greenhouse Gas Emissions: Sources and Trends* guidelines and uses Washington Department of Licensing Fuel Tax Receipts data. The default annual VMT data for in SGIT was the same as that provided by WSDOT.⁵² The state-level VMT was allocated to vehicle types using vehicle mix data from FHWA.⁵³

⁴⁷ <http://maritimeairforum.org/emissions.shtml>

⁴⁸ Waterman-Hoey and Nothstein, Department of Community, Trade and Economic Development. December 2006

⁴⁹ CO₂ emissions were calculated using SGIT, with reference to Emission Inventory Improvement Program, Volume VIII: Chapter. 1. "Methods for Estimating Carbon Dioxide Emissions from Combustion of Fossil Fuels", August 2004.

⁵⁰ CH₄ and N₂O emissions were calculated using SGIT, with reference to Emission Inventory Improvement Program, Volume VIII: Chapter. 3. "Methods for Estimating Methane and Nitrous Oxide Emissions from Mobile Combustion", August 2004.

⁵¹ Energy Information Administration, State Energy Consumption, Price, and Expenditure Estimates (SED), <http://www.eia.doe.gov/emeu/states/seds.html>

⁵² Pat Whittaker, Highway Performance Monitoring System Functional Classification Manager, Transportation Data Office, Washington Department of Transportation

⁵³ Highway Statistics, Federal Highway Administration, <http://www.fhwa.dot.gov/policy/ohpi/hss/index.htm>.

On-road Vehicles

On-road vehicle gasoline and diesel emissions were projected based on VMT forecasts provided by WSDOT⁵⁴ and growth rates developed from national vehicle type VMT forecasts reported in EIA's *Annual Energy Outlook 2006* (AEO2006). The AEO2006 data were incorporated because they indicate significantly different VMT growth rates for certain vehicle types (e.g., 28 percent growth between 2005 and 2020 in heavy-duty gasoline vehicle VMT versus 149 percent growth in light-duty diesel truck VMT over this period). The procedure first applied the AEO2006 vehicle type-based national growth rates to 2005 Washington estimates of VMT by vehicle type. These data were then used to calculate the estimated proportion of total VMT by vehicle type in each year. Next, these proportions were applied to the WSDOT estimates for total VMT in the State for each year to yield the vehicle type VMT estimates and compound annual average growth rates are displayed in Tables C2 and C3, respectively.

⁵⁴ VMT forecasts provided by Brian Lagerberg, WSDOT.

Table C1. Key Assumptions and Methods for the Transportation Inventory and Projections

Vehicle Type and Pollutants	Methods
Onroad gasoline, diesel, natural gas, and LPG vehicles – CO₂	<p>Inventory (1990 – 2005)</p> <p>EPA SGIT and fuel consumption from EIA SED and Washington Fuel Tax Receipts</p> <p>Reference Case Projections (2006 – 2020)</p> <p>Gasoline and diesel fuel projected using VMT projections provided by WSDOT adjusted by fuel efficiency improvement projections from AEO2006. Other onroad fuels projected using Pacific Region fuel consumption projections from EIA AEO2006 adjusted using state-to-regional ratio of population growth.</p>
Onroad gasoline and diesel vehicles – CH₄ and N₂O	<p>Inventory (1990 – 2005)</p> <p>EPA SGIT, onroad vehicle CH₄ and N₂O emission factors by vehicle type and technology type within SGIT were updated to the latest factors used in the U.S. EPA's <i>Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2003</i>.</p> <p>State total VMT replaced with VMT provided by WSDOT, VMT allocated to vehicle types using default data in SGIT.</p> <p>Reference Case Projections (2006 – 2020)</p> <p>VMT projections from WSDOT allocated to vehicle types using vehicle specific growth rates from AEO2006.</p>
Non-highway fuel consumption (jet aircraft, gasoline-fueled piston aircraft, boats, locomotives) – CO₂, CH₄ and N₂O	<p>Inventory (1990 – 2005)</p> <p>EPA SGIT and fuel consumption from EIA SED, except for commercial marine, which was taken from Puget Sound Maritime Air Forum and Corbett inventories and allocation of national fuel consumption data using port freight tonnage data.</p> <p>Reference Case Projections (2006 – 2020)</p> <p>Aircraft projected using aircraft operations projections from FAA. No growth assumed for rail diesel. Marine fuels projected based on historical data.</p>

Table C2. Washington Vehicle Miles Traveled Estimates (millions)

Vehicle Type	2002	2005	2010	2015	2020
Heavy Duty Diesel Vehicle	3,603	3,969	4,578	5,410	6,182
Heavy Duty Gasoline Vehicle	524	556	595	685	766
Light Duty Diesel Truck	538	619	845	1,200	1,668
Light Duty Diesel Vehicle	170	195	267	378	526
Light Duty Gasoline Truck	17,901	18,221	19,594	21,882	23,631
Light Duty Gasoline Vehicle	31,858	32,428	34,872	38,943	42,055
Motorcycle	182	185	199	223	240
Total	54,776	56,174	60,951	68,721	75,067

Table C3. Washington Vehicle Miles Traveled Compound Annual Growth Rates

Vehicle Type	2002-2005	2005-2010	2010-2015	2015-2020
Heavy Duty Diesel Vehicle	3.28%	2.90%	3.39%	2.70%
Heavy Duty Gasoline Vehicle	1.99%	1.38%	2.84%	2.27%
Light Duty Diesel Truck	4.76%	6.43%	7.26%	6.80%
Light Duty Diesel Vehicle	4.76%	6.43%	7.26%	6.80%
Light Duty Gasoline Truck	0.59%	1.46%	2.23%	1.55%
Light Duty Gasoline Vehicle	0.59%	1.46%	2.23%	1.55%
Motorcycle	0.59%	1.46%	2.23%	1.55%
Total	0.84%	1.65%	2.43%	1.78%

For forecasting GHG emissions, growth in fuel consumption is also needed along with VMT. Onroad gasoline and diesel fuel consumption were forecasted by developing a set of growth factors that adjusted the VMT projections to account for improvements in fuel efficiency. Fuel efficiency projections were taken from AEO2006.

Gasoline consumption projections were also adjusted to account for ethanol. According to fuel consumption data from EIA, motor gasoline consumed in Washington contained 2.7% ethanol in 2002. For the reference case projections, ethanol consumption was assumed to remain at 2.7% of gasoline consumption through 2020. For this inventory and reference case projection, ethanol is assumed to be carbon neutral, consistent with U.S. EPA GHG inventory procedures.

The on-road gasoline and diesel projections adjusted for fuel efficiency improvements and ethanol consumption suggest average on-road fuel consumption growth rates of 1.05% per year for gasoline and 3.16% per year for diesel between 2005 and 2020.

Washington recently adopted California's vehicle emission standards, which include greenhouse gas emission standards. Currently, these standards are being challenged in the courts by the automobile industry; therefore, the effects of these controls were not included in the baseline inventory.

Aviation

For the aircraft sector, emission estimates for 1990 to 2002 are based on SGIT methods and fuel consumption from EIA. Emissions for jet fuel were projected from 2002 to 2005 using historical jet fuel prime supplier sales volumes in Washington for 2002-2005 from EIA⁵⁵. Emissions for jet fuel were projected from 2005 to 2020 using commercial aircraft operations and emissions for aviation gasoline were projected from 2002-2020 using general aviation operations from the Federal Aviation Administration's Terminal Area Forecast System⁵⁶ and national aircraft fuel efficiency forecasts. To estimate changes in jet fuel consumption, itinerant aircraft operations from air carrier, air taxi/commuter, and military aircraft were first summed for each year of interest. The post-2005 estimates were adjusted to reflect the projected increase in national aircraft fuel efficiency (indicated by increased number of seat miles per gallon), as reported in AEO2006. Because AEO2006 does not estimate fuel efficiency changes for general aviation aircraft, forecast changes in aviation gasoline consumption were based solely on the projected number of itinerant general aviation aircraft operations in Washington, which was obtained from the FAA source noted above. The resulting compound annual average growth rates are displayed in Table C4.

Table C4. Washington Aviation Fuels Compound Annual Growth Rates

Fuel	2002-2005	2005-2010	2010-2015	2015-2020
Aviation Gasoline	-0.59%	1.46%	1.43%	1.17%
Jet Fuel	0.64%	0.85%	0.52%	0.41%

Rail

For the railroad sector, 1990 – 2004 estimates are based on SGIT methods and fuel consumption from EIA. The historic data for rail shows no significant positive or negative trend; therefore, no growth was assumed for this sector.

Marine

Estimates of commercial marine emissions and fuel consumption were taken from different sources for four areas: Puget Sound, the Columbia and Snake Rivers, other coastal ports, and offshore. Table C5 summarizes the methodology for estimating commercial marine emissions. For the Puget Sound area (Island, Skagit, Whatcom, King, Kitsap, Pierce, Snohomish, Clallam, Jefferson, Mason, and Thurston Counties) base year (2005) emissions were taken from the recent Puget Sound Maritime Forum inventory. For the Columbia and Snake Rivers, total 1999 fuel consumption by commercial marine vessels was taken from an inventory developed by Corbett for WA Ecology.⁵⁷ Base year (2002) off-shore emissions within state territorial waters (200 nautical miles from shore) were estimated based on a study by Corbett.⁵⁸ Other Washington

⁵⁵ Washington Prime Supplier Sales Volumes of Petroleum Products, Energy Information Administration, http://tonto.eia.doe.gov/dnav/pet/pet_cons_prim_dcua_SWA_a.htm.

⁵⁶ Terminal Area Forecast, Federal Aviation Administration, <http://www.apo.data.faa.gov/main/taf.asp>.

⁵⁷ Corbett, J., "Commercial Marine Vessel Inventory Review and Preparation for the Northwest U.S.", Prepared for the Washington Department of Ecology, May, 2001.

⁵⁸ Estimate, Validation, and Forecasts of Regional Commercial Marine Vessel Inventories, submitted by J. Corbett, prepared for the California Air Resources Board, California Environmental Protection Agency, and Commission for Environmental Cooperation in North America, <http://coast.cms.udel.edu/NorthAmericanSTEEM/>.

coastal port historic emissions were estimated by allocating national EIA marine fuel consumption data in proportion to port tonnage. For Columbia/Snake River, coastal, and off-shore estimates, fuel consumption was allocated to residual and diesel fuel in order to calculate emissions. More detail on each of these estimates are described below.

Table C5. Summary of Methodology for Commercial Marine Fuel Emissions

	Source of Historic Emissions	Source of Current Year Emissions	Source of Forecasts
Off-shore	Backcast based on ratio of Seattle+ Tacoma tonnage (from ACE)	2002 emissions from Corbett study	RTI forecast of North Pacific commercial marine fuel use (developed for EPA by RTI); CAGR=2.95%
Columbia/Snake Rivers	Backcast based on Columbia River System tonnage	Based on 1999 marine fuel use from Corbett inventory for ECY	Linear trend of 1992-2005 Columbia River System tonnage (from ACE); CAGR=-0.71
Coastal	EIA fuel use allocated based on port tonnage	EIA fuel use allocated based on port tonnage	Linear trend of 1992-2005 WA coastal tonnage (from ACE); CAGR=-1.15%
Puget Sound – Containership	Backcast based on ratio of Seattle+ Tacoma TEUs	2005 emissions from PS Maritime Air Forum	Seattle+Tacoma TEU growth 1990-2005; CAGR=4.17%
Puget Sound – Other OGV	Backcast based on ratio of Seattle+ Tacoma tonnage (from ACE)	2005 emissions from PS Maritime Air Forum	Linear trend of 1992-2005 Seattle+ Tacoma tonnage (from ACE); CAGR=1.05%
Puget Sound – Ferries	Assume constant	2005 emissions from PS Maritime Air Forum	WSDOT Ferries Draft Strategic Plan, hours of operation; CAGR=1.5% (2005-15); CAGR=1.7% (2015-20)
Puget Sound – Tugs and Other Harbor Craft	Backcast based on ratio of total OGV emissions	2005 emissions from PS Maritime Air Forum	Proportional to total OGV forecast emissions; CAGR=2.67%

To estimate historic and future emissions from Puget Sound commercial marine activity, four types of vessels were considered, on the assumption that growth rates would differ by these vessel types: containerships, other ocean-going vessels (OGVs), ferries, other harbor craft (primarily tugs). These methods are summarized as follows:

- Containership emissions for 1990-2004 were estimated by scaling 2005 emissions based on the combined volume of twenty-foot equivalent units (TEUs) at the Port of Tacoma and Port of Seattle. Future year containership emissions were estimated using a growth factor that reflects the 1990-2006 compound annual growth in TEUs at the two ports (4.17%).
- Other OGV emissions for 1990-2004 were estimated by scaling 2005 emissions based on the combined tonnage at the Port of Tacoma and Port of Seattle, as reported the Corps of Engineers “Waterborne Commerce of the United States”. Future year emissions from

other OGVs were estimated to grow in proportion to a projected linear regression of 1990-2005 tonnage at the Port of Tacoma and Seattle (or 1.05% compounded annually).

- 1990-2004 emissions from Puget Sound ferries were assumed to be equal to 2005 emissions. Future year ferry emissions were estimated using growth rates for ferry hours of operation presented in the Washington State Ferries draft *Long-Range Strategic Plan*.⁵⁹ These compound annual growth rates are 1.5% for the period 2005-2015 and 1.7% for 2015-2020.
- To estimate 1990-2004 emissions from other Puget Sound harbor craft, we scaled the 2005 emissions based on the ratio of emissions from Puget Sound OGVs. Future year emissions from other harbor craft were assumed to grow in proportion to total Puget Sound OGV emission (2.67% compounded annually).

Table C6 shows the fuel consumption estimates for the Columbia and Snake Rivers and the amount of fuel included in this inventory. For sections of river along the border between Washington and Oregon, half of the fuel consumption is assumed to occur in Washington. Future year emissions for the Columbia and Snake Rivers were estimated based on a linear projection of marine tonnage on this system, as reported the Corps of Engineers “Waterborne Commerce of the United States” (compound annual growth of -1.15%).

Table C6. 1999 Fuel Use by Commercial Marine Vessels in Columbia and Snake Rivers

River Name	Total Fuel Use (1,000 gallons)	Total in WA (1,000 gallons)
Snake River	2,133	2,133
Columbia River Entrance	1,298	649
Willamette above Portland and Yamhill	79	0
Columbia at Bakers Bay	0.5	0.5
Lower Willamette	2,176	0
Columbia & Lower Willamette below Vancouver	24,046	12,023
Columbia between Vancouver and the Dalles	3,687	1,844
Columbia above the Dalles Dam to McNary Lock & Dam	3,459	1,730
Columbia above McNary Lock & Dam to Kennewick	1,236	618
Columbia between Wenatchee & Kettle Falls	7	7
Total	38,119	19,002

Fuel consumption estimates for Washington coastal ports (not covered by the Puget Sound inventory), and for the Columbia/Snake Rivers for the purpose of allocating total fuel consumption, were developed by allocating 1990-2004 national diesel and residual oil vessel bunkering fuel consumption estimates obtained from EIA.⁶⁰ Marine vessel fuel consumption was allocated to using the marine vessel activity allocation methods/data compiled to support the

⁵⁹ See <http://www.wsdot.wa.gov/ferries/planning>

⁶⁰ U.S. Department of Energy, Energy Information Administration, “Petroleum Navigator” (diesel data obtained from <http://tonto.eia.doe.gov/dnav/pet/hist/kd0vabnus1a.htm>; residual data obtained from <http://tonto.eia.doe.gov/dnav/pet/hist/kprvatnus1a.htm>).

development of EPA's National Emissions Inventory (NEI).⁶¹ In keeping with the NEI, 75 percent of each year's distillate fuel and 25 percent of each year's residual fuel were assumed to be consumed within the port area (remaining consumption is assumed to occur while ships are underway). National port area fuel consumption was allocated to this area based on year-specific freight tonnage data for the top 150 ports in the nation as reported in "Waterborne Commerce of the United States, Part 5 – Waterways and Harbors National Summaries."⁶² Emissions were then estimated from fuel consumption estimates using SGIT emissions factors for marine diesel and residual fuels.

Offshore estimates of CO₂ and hydrocarbon (HC) emissions for marine vessels in Washington's exclusive economic zone (EEZ) was taken from a study by Corbett for the Commission for Environmental Cooperation in North America (CEC).⁶³ Offshore CH₄ emissions were estimated by estimating the HC emissions using the CARB TOG profile (#818).⁶⁴ Offshore N₂O emissions were estimated by applying the ratio of N₂O to CH₄ emission factors to the CH₄ emission estimate. The 2002 offshore emissions from the CEC inventory were scaled to other historic years based on the combined tonnage handled at the ports of Seattle and Tacoma, as reported in the Corps of Engineers "Waterborne Commerce of the United States, Part 5 – Waterways and Harbors National Summaries." Future year off-shore emissions were estimated using a growth factor (2.95% compound annual growth) for North Pacific commercial marine fuel developed by Research Triangle Institute for the U.S. EPA.

Nonroad Engines

It should be noted that fuel consumption data from EIA includes nonroad gasoline and diesel fuel consumption in the commercial and industrial sectors. Emissions from these nonroad engines are included in the RCI emissions in this inventory (see Appendix B). Table C7 shows how EIA divides gasoline and diesel fuel consumption between the transportation, commercial, and industrial sectors.

Table C7. EIA Classification of Gasoline and Diesel Consumption

Sector	Gasoline Consumption	Diesel Consumption
Transportation	Highway vehicles, marine	Vessel bunkering, military use, railroad, highway vehicles
Commercial	Public non-highway, miscellaneous use	Commercial use for space heating, water heating, and cooking
Industrial	Agricultural use, construction, industrial and commercial use	Industrial use, agricultural use, oil company use, off-highway vehicles

⁶¹ See methods described in

ftp://ftp.epa.gov/EmisInventory/2002finalnei/documentation/mobile/2002nei_mobile_nonroad_methods.pdf

⁶² Note that it was necessary to estimate 1990-1992 values by interpolating between by forecasting back from 1993-2004 data.

⁶³ Estimate, Validation, and Forecasts of Regional Commercial Marine Vessel Inventories, submitted by J. Corbett, prepared for the California Air Resources Board, California Environmental Protection Agency, and Commission for Environmental Cooperation in North America, <http://coast.cms.udel.edu/NorthAmericanSTEEM/>.

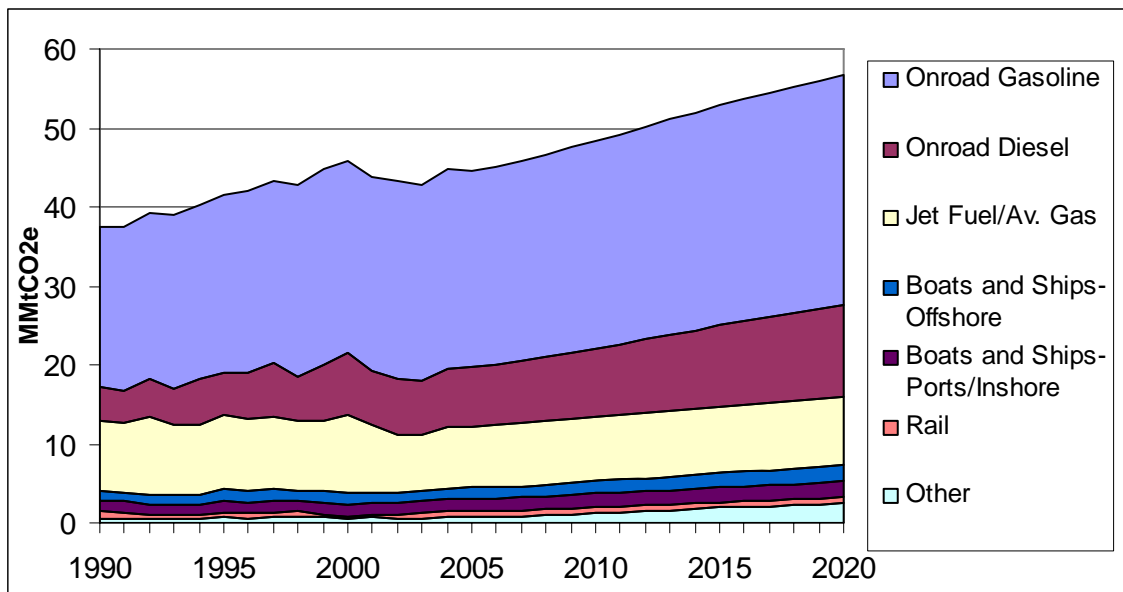
⁶⁴ California Air Resources Board, Speciation Profiles, <http://www.arb.ca.gov/ei/speciate/speciate.htm>.

Results

As shown in Figure C1, on-road gasoline consumption accounts for the largest share of transportation GHG emissions. Emissions from on-road gasoline vehicles increased by 21% from 1990-2005 to account for 56% of total transportation emissions in 2005. GHG emissions from on-road diesel fuel consumption increased by 85% from 1990 to 2005, and by 2005 accounted for 17% of GHG emissions from the transportation sector. The historical data shows a decrease in aviation and diesel fuel consumption between 2000 and 2005, due in part to the economic downturn during that period. Washington's gross state product (GSP) grew at an average rate of 7.1% per year between 1990 and 1999, however, the rate of growth slowed to 2.6% per year between 2000 and 2002. Due to the large decrease in aviation fuel consumption during the first half of this decade, emissions from aviation decreased by 14% between 1990 and 2005. In 2005 jet fuel and marine fuels accounted for 17% and 7% of total transportation emissions, respectively. Emissions from all other categories combined (locomotives, natural gas and LPG, and oxidation of lubricants) contributed approximately 3% of total transportation emissions in 2005.

GHG emissions from all on-road vehicles combined are projected to increase by 27% between 2005 and 2020, due to a 34% increase in VMT during this period and projected fuel efficiency improvements. Historical growth for diesel fuel was much stronger than for gasoline. This trend is expected to continue for the 2005-2020 period, with gasoline and diesel fuel consumption projected to increase by 18% and 57%, respectively. Jet fuel and aviation gasoline consumption is projected to increase by 9% between 2005 and 2020.

Figure C1. Transportation GHG Emissions by Fuel, 1990-2020



Key Uncertainties

Projections of Vehicle Miles of Travel (VMT) and Biofuels Consumption

One source of uncertainty is the future year vehicle mix, which was calculated based on national growth rates for specific vehicle types. These growth rates may not reflect vehicle-specific VMT growth rates for the state. Also, on-road gasoline and diesel growth rates may be slightly overestimated because increased consumption of biofuels between 2005 and 2020 was not taken into account (due to a lack of data).

Uncertainties in Aviation Fuel Consumption

The consumption of international bunker fuels included in jet fuel consumption from EIA is another uncertainty. This fuel consumption associated with international air flights should not be included in the state inventory (as much of it is actually consumed out of state); however, data were not available to subtract this consumption from total jet fuel estimates. Another uncertainty associated with aviation emissions is the use of general aviation forecasts to project aviation gasoline consumption. General aviation aircraft consume both jet fuel and aviation gasoline, but fuel specific data were not available.

Appendix D. Industrial Processes

Overview

Emissions in the industrial processes category span a wide range of activities, and reflect non-combustion sources of GHG emissions from several industrial processes. The industrial processes that exist in Washington, and for which emissions are estimated in this inventory and reference case projection prepared for the Washington Climate Advisory Team (CAT), include the following:

- Carbon Dioxide (CO₂) from:
 - Production of cement;
 - Consumption of limestone, dolomite, and soda ash;
- Hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF₆) from semiconductor manufacture;
- CO₂, tetrafluoromethane (CF₄), and Hexafluoroethane (C₂F₆) from aluminum production;
- SF₆ from transformers used in electric power transmission and distribution (T&D) systems; and
- HFCs and PFCs from consumption of substitutes for ozone-depleting substances (ODS) used in cooling and refrigeration equipment.

Washington produces small amounts of lime and nitric acid. These processes emit GHGs but the low levels of production in Washington are expected to generate relatively low GHG emissions. This version of the GHG inventory and projections excludes estimates for these processes, but they may be included in future revisions pending data availability.

Other industrial processes that are sources of GHG emissions but are not found in Washington include the following:

- Nitrous oxide (N₂O) from adipic acid production;
- SF₆ from magnesium production and processing;
- CO₂ from soda ash production; and
- HFCs from HCFC-22 production.

Data Sources and Approach

GHG emissions for 1990 through 2005 were estimated using the United States Environmental Protection Agency's (US EPA) State Greenhouse Gas Inventory Tool (SGIT) software and the methods provided in the Emission Inventory Improvement Program (EIIP) guidance document for this sector.⁶⁵ Table D1 identifies for each emissions source category the information needed for input into SGIT to calculate emissions, the data sources used for the analysis described here, and the historical years for which emissions were calculated based on the availability of data. The

⁶⁵ GHG emissions were calculated using SGIT, with reference to EIIP, Volume VIII: Chapter. 6. "Methods for Estimating Non-Energy Greenhouse Gas Emissions from Industrial Processes", August 2004. Referred to as "EIIP" below.

Washington Department of Ecology's GHG inventory for 1990 through 2004 (recently updated in 2006⁶⁶) for all of the categories shown in Table D1 (except for the consumption of limestone, dolomite, and soda ash) was used in preparing the inventory described in this appendix. The Center for Climate Strategies included emission estimates for the consumption of limestone, dolomite, and soda ash in this inventory to maintain consistency with US EPA methods.

Table D1. Approach to Estimating Historical Emissions

Source Category	Time Period	Required Data for SGIT	Data Source
Cement Manufacturing - Clinker Production	1990 - 2004	Metric tons (Mt) of clinker produced each year.	Washington Department of Ecology provided annual emission estimates for 1990 through 2004 based on actual production data for each year.
Aluminum Production	1990 - 2004	Mt of aluminum produced each year.	Washington Department of Ecology provided annual emission estimates for 1990 through 2004 based on actual production data for each year.
Limestone and Dolomite Consumption	1990 - 2002	Mt of limestone and dolomite consumed.	Used default consumption data available in SGIT for 1994 through 2002. Default data for 1990 through 1993 were not available in SGIT. For default data, the state's total limestone consumption (as reported by USGS ⁶⁷) is multiplied by the ratio of national limestone consumption for industrial uses to total national limestone consumption. Additional information on these calculations, including a definition of industrial uses, is available in Chapter 6 of the EIIP guidance document (see footnote 1 for reference to EIIP guidance document).
Soda Ash Consumption	1990 - 2002	Mt of soda ash consumed.	<i>USGS Minerals Yearbook, 2004: Volume I, Metals and Minerals</i> , (http://minerals.usgs.gov/minerals/pubs/commodity/soda_ash/). For population data, see references for ODS substitutes.
ODS Substitutes	1990 - 2004	Based on state's population and estimates of emissions per capita from the US EPA national GHG inventory.	Washington Department of Ecology provided annual emission estimates based on the SGIT methodology for 1990 through 2004.
Semiconductor Manufacturing	1990 - 2004	State and national value of semiconductor shipments for NAICS code 334413 (Semiconductor and Related Device Manufacturing). Method uses ratio of state-to-national value of semiconductor shipments to estimate state's proportion of national emissions for 1990 - 2002.	Washington Department of Ecology provided annual emission estimates based on the SGIT methodology for 1990 through 2004.
Electric Power T&D Systems	1990 - 2004	Emissions from 1990 to 2004 based on the national emissions per kWh and state's electricity use provided in SGIT.	Washington Department of Ecology provided annual emission estimates based on the SGIT methodology for 1990 through 2004.

⁶⁶ *Washington's Greenhouse Gas Emissions: Sources and Trends*, by Stacey Waterman-Hoey and Greg Nothstein, WA State Dept. of Community, Trade & Economic Development, Energy Policy Division, dated December 2006 (Revised 2/12/07), and available from http://www.cted.wa.gov/portal/alias_CTED/lang_en/tabID_853/DesktopDefault.aspx.

⁶⁷ United States Geological Survey.

Table D2 lists the data sources used to quantify activities related to industrial process emissions, the annual compound growth rates implied by estimates of future activity used, and the years for which the reference case projections were calculated.

Table D2. Approach to Estimating Projections

Source Category	Time Period	Projection Assumptions	Data Source	Annual Growth Rates (%)			
				2000 to 2005	2005 to 2010	2010 to 2015	2015 to 2020
Cement Manufacturing - Clinker Production	2005 - 2020	Compound annual growth rate in employment for Washington's nonmetallic mineral products sector.	Washington State Employment Security Department, Labor Market and Economic Analysis, Workforce Employer, Publications and Reports, Located under "Projections / Long-term Employment Projections."	None*	1.14	1.14	1.14
Limestone and Dolomite Consumption	2003 - 2020	Ditto	Ditto	1.14	1.14	1.14	1.14
Aluminum Production	2005 - 2020	Compound annual growth rate in employment for Washington's primary metals sector.	Ditto	None*	-0.42	-0.42	-0.42
Soda Ash Consumption	2003 - 2020	Growth between 2004 and 2009 is projected to be about 0.5% per year for US production. Assumed growth is same for 2010 – 2020.	<i>Minerals Yearbook, 2005: Volume I, Soda Ash</i> , (http://minerals.usgs.gov/minerals/pubs/commodity/soda_ash/soda_myb05.pdf).	0.5	0.5	0.5	0.5
ODS Substitutes	2005 - 2020	Based on national growth rate for use of ODS substitutes.	EPA, 2004 ODS substitutes cost study report (http://www.epa.gov/ozone/snap/emissions/TMP6si9htnvca.htm).	None*	7.9	5.8	5.3
Semiconductor Manufacturing	2005 - 2020	National growth rate (based on aggregate for all stewardship program categories provided in referenced data source)	US Department of State, <i>US Climate Action Report</i> , May 2002, Washington, D.C., May 2002 (Table 5-7). (http://yosemite.epa.gov/oar/globalwarming.nsf/UniqueKeyLookup/SHSU5BNQ76/\$File/ch5.pdf).	None*	-6.2	-9.0	-2.8
Electric Power T&D Systems	2005 - 2020	Ditto	Ditto	None*	-6.2	-9.0	-2.8

* Actual data used for 2000 – 2004.

Results

Figures D1 and D2 show historic and projected emissions for the industrial processes sector from 1990 to 2020. Total gross Washington GHG emissions from industrial processes were about 7.0 MMTCO₂e in 1990, declined to about 3.3 MMTCO₂e in 2005, but are projected to increase to about 6.2 MMTCO₂e in 2020. The fluctuation in historical emissions (see Figures D1 and D2) is associated with the interaction between declining production activity in the aluminum industry, and the growth in emissions associated with the use of ODS substitutes that offset the decline in

aluminum production emissions. Future emissions are expected to grow rapidly, as shown in Figures D1 and D2, with emissions growth primarily associated with increasing use of HFCs and PFCs in refrigeration and air conditioning equipment.

Substitutes for Ozone-Depleting Substances (ODS)

HFCs and PFCs are used as substitutes for ODS, most notably CFCs (CFCs are also potent warming gases, with global warming potentials on the order of thousands of times that of CO₂ per unit of emissions) in compliance with the *Montreal Protocol* and the *Clean Air Act Amendments of 1990*.⁶⁸ Even low amounts of HFC and PFC emissions, for example, from leaks and other releases associated with normal use of the products, can lead to high GHG emissions on a carbon-equivalent basis. GHG-equivalent emissions from the use of ODS substitutes in Washington were calculated using the default methods in SGIT (see dark green line in Figure D2). Emissions have increased from 0.007 MMtCO₂e in 1990 to about 1.6 MMtCO₂e in 2000, and are expected to increase at an average rate of 6.1% per year from 2000 to 2020 due to increased substitutions of these gases for ODS. The projected rate of increase for these emissions is based on projections for national emissions from the US EPA report referenced in Table D2.

Aluminum Production

The Washington Department of CTED prepared annual emission estimates for primary aluminum production for 1990 through 2004 based on actual production data for each year. The aluminum production industry is thought to be the largest source of two perfluorocarbons (PFCs) – tetrafluoromethane (CF₄) and hexafluoroethane (C₂F₆). Emissions of these two potent GHGs occur during the reduction of alumina in the primary smelting process (see footnote 1 for reference to EIIP guidance document). The employment growth rate for Washington's primary metals sector was used to project emissions to 2020. As shown in Figure D2 (see dark blue line), emissions in 1990 were 5.89 MMtCO₂e, declined by about one-third to 3.91 MMtCO₂e in 1995, increased slightly to about 3.94 MMtCO₂e in 2000, and then declined sharply to about 0.36 MMtCO₂e in 2005. From 2005 forward, emissions are projected to decline to about 0.34 MMtCO₂e in 2020, reflecting an overall average annual decrease of about 0.42% over that time period.

⁶⁸ As noted in EIIP Chapter 6, ODS substitutes are primarily associated with refrigeration and air conditioning, but also many other uses including as fire control agents, cleaning solvents, aerosols, foam blowing agents, and in sterilization applications. The applications, stocks, and emissions of ODS substitutes depend on technology characteristics in a range of equipment types. For the US national inventory, a detailed stock vintaging model was used to track ODS substitutes uses and emissions, but this modeling approach has not been completed at the state level.

Figure D1. GHG Emissions from Industrial Processes, 1990-2020

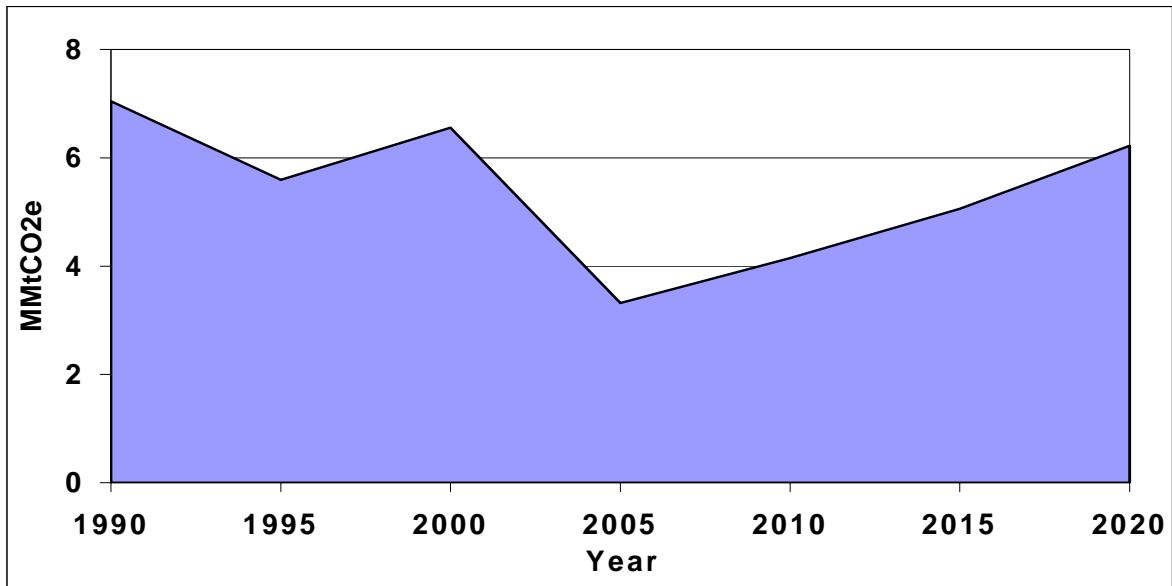
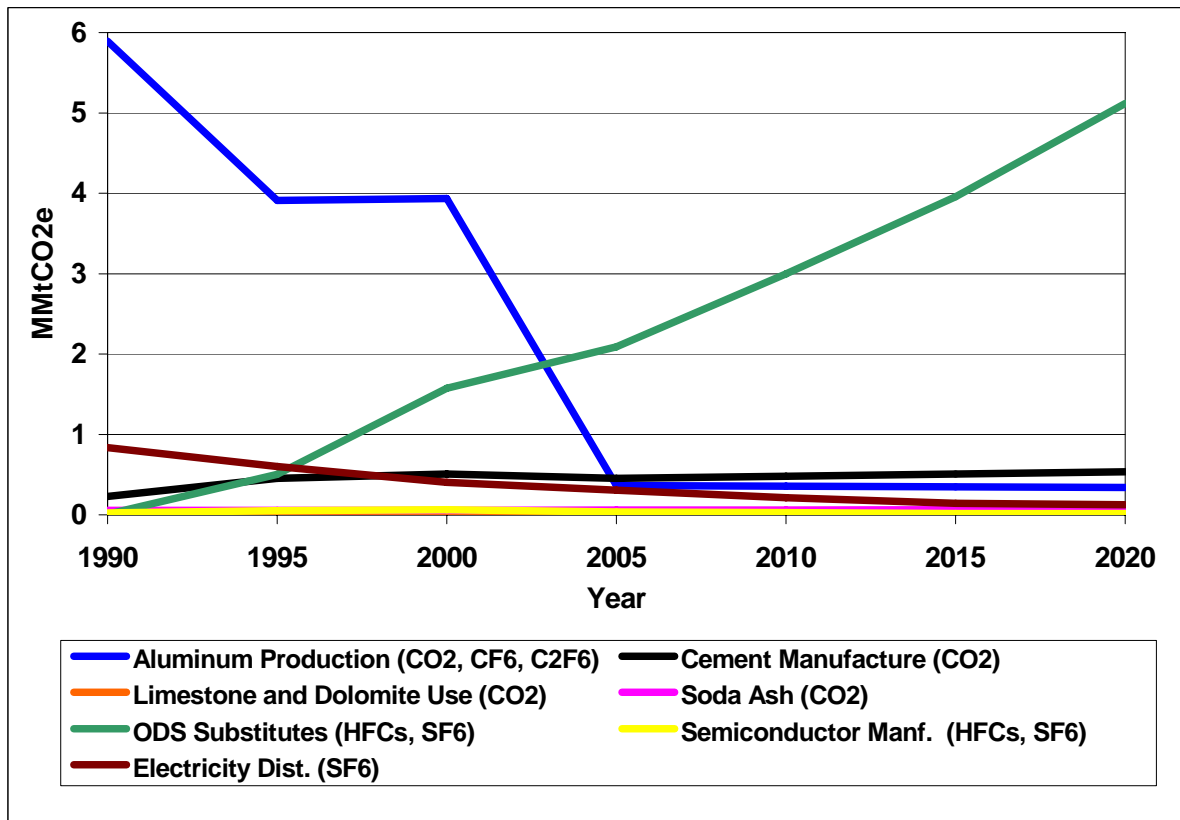


Figure D2. GHG Emissions from Industrial Processes, 1990-2020, by Source



Electricity Distribution

Emissions of SF₆ from electrical equipment have experienced declines since the early nineties (see brown line in Figure D2), mostly due to voluntary action by industry. SF₆ is used as an electrical insulator and interrupter in electricity T&D systems. Emissions for Washington from 1990 to 2002 were estimated based on the estimates of emissions per kWh from the US EPA GHG inventory and Washington's electricity consumption estimates provided in SGIT. The *US Climate Action Report* shows expected decreases in these emissions at the national level, and the same rate of decline is assumed for emissions in Washington. The decline in SF₆ emissions in the future reflects expectations of future actions by the electric industry to reduce these emissions. Relative to total industrial non-combustion process emissions, SF₆ emissions from electrical equipment are low (about 0.84 MMtCO_{2e} in 1990 and 0.12 MMtCO_{2e} in 2020), and therefore appear at the bottom of the graph because of scaling effects in Figure D2.

Semiconductor Manufacture

Emissions of SF₆ and HFCs from the manufacture of semiconductors have experienced declines since 2000 (see yellow line in Figure D2). Emissions for Washington from 1990 to 2004 were estimated based on the default estimates provided in SGIT, which uses the ratio of the state-to-national value of semiconductor shipments to estimate the state's proportion of national emissions from the US EPA GHG inventory (US EPA 2005 *Inventory of US Greenhouse Gas Emissions and Sinks: 1990-2003*). The *US Climate Action Report* shows expected decreases in these emissions at the national level, and the same rate of decline is assumed for emissions in Washington. The decline in emissions in the future reflects expectations of future actions by the semiconductor industry to reduce these emissions. Relative to total industrial non-combustion process emissions, emissions associated with semiconductor manufacturing are low (about 0.024 MMtCO_{2e} in 1990 and 0.015 MMtCO_{2e} in 2020), and therefore appear at the bottom of the graph because of scaling effects in Figure D2.

Clinker Production for Cement Manufacture

Washington Department of Ecology prepared annual emission estimates for clinker production for 1990 through 2004 based on actual production data for each year. Clinker is an intermediate product from which finished Portland and masonry cement are made. Clinker production releases CO₂ when calcium carbonate (CaCO₃) is heated in a cement kiln to form lime (calcium oxide) and CO₂ (see footnote 1 for reference to EIIP guidance document). Emissions are calculated by multiplying annual clinker production and annual production of masonry cement by emission factors for these processes. Information on masonry cement production was not available. The employment growth rate for Washington's nonmetallic mineral products sector was used to project emissions to 2020. As shown in Figure D2 (see black line), emissions in 1990 were 0.23 MMtCO_{2e}, increased to about 0.51 MMtCO_{2e} in 2000, and declined to about 0.45 MMtCO_{2e} by 2005. From 2005 forward, emissions are projected to increase to about 0.54 MMtCO_{2e} in 2020, reflecting an overall average annual increase of about 1.14% over that time period.

Limestone and Dolomite Consumption

Limestone and dolomite are basic raw materials used by a wide variety of industries, including the construction, agriculture, chemicals, glass manufacturing, and environmental pollution

control industries, as well as in metallurgical industries such as magnesium production.⁶⁹ Recent historical data for Washington were not available from the USGS; consequently, the default data provided in SGIT were used to calculate emissions for Washington from the use of these materials (see orange line in Figure D2). The employment growth rate for Washington's nonmetallic mineral products sector was used to project emissions from 2003 through 2020. Relative to total industrial non-combustion process emissions, emissions associated with limestone and dolomite consumption are low (about 0.023 MMtCO₂e in 1995 and 0.027 MMtCO₂e in 2020), and therefore appear at the bottom of the graph in Figure D2 due to scaling effects. Note that for this sector, SGIT did not contain default consumption data for Washington for 1990 through 1993, and therefore emissions were not estimated for these years.

Soda Ash Consumption

Commercial soda ash (sodium carbonate) is used in the manufacture of many consumer products such as glass, soap and detergents, paper, textiles, and food. CO₂ is also released when soda ash is consumed (see footnote 1 for reference to EIIP guidance document). SGIT estimates historical emissions (see dark pink line in Figure D2) based on the state's population and national per capita emissions from the US EPA national GHG inventory. According to the USGS, this industry is expected to grow at an annual rate of 0.5% from 2004 through 2009 for the US as a whole. Information on growth trends for years later than 2009 was not available; therefore the same 0.5% annual growth rate was applied for estimating emissions to 2020. Relative to total industrial non-combustion process emissions, emissions associated with soda ash consumption are low (about 0.053 MMtCO₂e in 1990 and 0.061 MMtCO₂e in 2020), and therefore cannot be seen in the graph due to scaling effects in Figure D2.

Key Uncertainties

Key sources of uncertainty underlying the estimates above are as follows:

- Since emissions from industrial processes are determined by the level of production and the production processes of a few key industries, and in some cases, a few key plants, there is relatively high uncertainty regarding future emissions from the industrial processes category as a whole. Future emissions depend on the competitiveness of Washington manufacturers in these industries, and on the specific nature of the production processes used in Washington.
- The projected largest source of future industrial emissions, HFCs and PFCs used in cooling applications, is subject to several uncertainties as well. First, historical emissions are based on national estimates; Washington-specific estimates are currently unavailable. In addition, emissions through 2020 and beyond will be driven by future choices regarding mobile and stationary air conditioning technologies and the use of refrigerants in commercial applications, for which several options currently exist.

⁶⁹ In accordance with EIIP Chapter 6 methods, emissions associated with the following uses of limestone and dolomite are not included in this category: (1) crushed limestone consumed for road construction or similar uses (because these uses do not result in CO₂ emissions), (2) limestone used for agricultural purposes (which is counted under the methods for the agricultural sector), and (3) limestone used in cement production (which is counted in the methods for cement production).

- State-specific industrial consumption data were not available for use of limestone or of dolomite and soda ash. For this initial inventory, the default activity in SGIT was used to estimate emissions. The inventory for these categories can be improved upon in the future by obtaining actual production and consumption data for these industries by contacting the companies that sell limestone and dolomite and soda ash to industries in Washington.
- Greenhouse gases are emitted from several additional industrial processes that are not covered in the EIIP guidance documents, due in part to a lack of sufficient state data on non-energy uses of fossil fuels for these industrial processes. These sources include:
 - Iron and Steel Production (CO₂ and CH₄);
 - Ammonia Manufacture and Urea Application (CO₂, CH₄, N₂O);
 - Aluminum Production (CO₂);
 - Titanium Dioxide Production (CO₂);
 - Phosphoric Acid Production (CO₂);
 - CO₂ Consumption (CO₂);
 - Ferroalloy Production (CO₂);
 - Petrochemical Production (CH₄); and
 - Silicon Carbide Production (CH₄).

The CO₂ emissions from the CO₂ sources above (other than CO₂ consumption and phosphoric acid production) result from the non-energy use of fossil fuels. Although the US EPA estimates emissions for these industries on a national basis, US EPA has not developed methods for estimating the emissions at the state level due to data limitations. If state-level data on non-energy uses of fuels become available, future work should include an assessment of emissions for these other categories.

Appendix E. Fugitive Emissions from Fossil Fuel Industries

This appendix reports the additional GHG emissions that are released during the production, processing, transmission, and distribution of fossil fuels. Known as fugitive emissions, these are methane emissions released via leakage and venting at coal mines, oil and gas fields, processing facilities, and pipelines. In 2004, fugitive emissions from natural gas systems, petroleum systems, and coal mines accounted for 2.8% of total US greenhouse gas emissions.⁷⁰ Emissions associated with energy consumed by these processes are included in Appendix B, Residential, Commercial and Industrial Sectors.

Oil and Gas Production

Washington does not have any indigenous oil or natural gas production. Washington's five oil refineries import crude oil from the Alaska North Slope, Canada, and other locations, and have a combined capacity of 624 thousand barrels per day, supplying markets throughout the Northwest region.

There is no active oil or gas production in Washington; a few exploratory wells are drilled each year or two but no commercial production is occurring. Thus, emissions of methane (CH₄) occur only from processing, transmission and distribution systems. Washington has five oil refineries, one natural gas geologic storage reservoir, two LNG storage compressor stations and over 2,000 miles of gas pipelines.⁷¹ Uncertainties associated with estimates of Washington's GHG emissions from the oil and gas sector are compounded by the fact that there are no regulatory requirements to track CO₂ or methane emissions. Therefore, estimates based on actual emissions measurements in Washington are not possible at this time.

Data Sources and Approach

The State Greenhouse Gas Inventory Tool (SGIT), developed by the US EPA, facilitates estimation of state-level greenhouse gas emissions.⁷² Methane emission estimates are calculated by multiplying emissions-related activity levels (e.g. miles of pipeline, number of compressor stations) by aggregate industry-average emission factors. Key information sources for the activity data are the US DOE EIA⁷³ and Office of Pipeline Security Distribution and Transmission Annuals 1990- 2005.⁷⁴ Methane emissions were estimated using SGIT, with reference to the EIIP guidance document.

Future projections of methane emissions from oil and gas systems are calculated based on the following key drivers:

- Consumption – See Appendix A, Electricity, and Appendix B, Residential, Commercial and Industrial Sector for assumptions used in projecting natural gas consumption in Washington.

⁷⁰ “The US Inventory of Greenhouse Gas Emissions and Sinks”, US EPA, 2005.

⁷¹ Data from EIA and Gas Facts.

⁷² Methane emissions were calculated using SGIT, with reference to Emission Inventory Improvement Program, Volume VIII: Chapter. 5. “Methods for Estimating Methane Emissions from Natural Gas and Oil Systems”, March 2005.

⁷³ “Petroleum Navigator” and “Natural Gas Navigator”, US DOE Energy Information Administration website, November 2006, Accessed at <http://www.eia.doe.gov>

⁷⁴ <http://ops.dot.gov/stats/stats.htm#additional>.

Based on those assumptions, Washington's natural gas consumption is projected to grow at an annual rate of about 1.5% until 2020.

- Processing – Refining and transportation rates are forecast to follow recent trends in the State through 2020. Any additional transmission lines in the State may significantly increase actual emission levels, input from reviewers in this regard is welcomed.

Table E1 provides an overview of data sources and approach used to project future emissions.

Table E1. Approach to Estimating Historical and Projected Methane Emissions from Natural Gas and Oil Systems.

<i>Activity</i>	Approach to Estimating Historical Emissions		Approach to Estimating Projections
	<i>Required Data for SGIT</i>	<i>Data Source</i>	<i>Projection Assumptions</i>
Natural Gas Transmission	Miles of transmission pipeline	Office of Pipeline Security	Emissions are held flat at 2004 levels. ⁷⁵
	Number of gas transmission compressor stations	EIIP ⁷⁶	
	Number of gas storage compressor stations	EIIP ⁷⁷	
	Number of LNG storage compressor stations	Federal Energy Regulatory Commission ⁷⁸	
Natural Gas Distribution	Miles of distribution pipeline	Office of Pipeline Security	Distribution emissions follow State gas consumption trend - annual average growth rate of 1.5% between 2006 and 2020. ⁷⁹
	Total number of services		
	Number of unprotected steel services	Ratio estimated from 2002 data ⁸⁰	
	Number of protected steel services	Ratio estimated from 2002 data ⁸⁰	
Oil Refining	Annual amount refined	EIA ⁸¹	Emissions projected to follow trend of 1.6% annual growth in state oil refining. ⁸²
Oil Transport	Annual oil transported	Unavailable, assumed oil refined = oil transported	Emissions follow trend of state oil refining, as above.

⁷⁵ Any new transmission lines proposed for Washington could significantly increase projected emission levels. Review of the Washington State Energy Facility Site Evaluation Council (EFSEC) website did not reveal any proposed transmission lines that have entered the permitting process.

⁷⁶ Number of gas transmission compressor stations = miles of transmission pipeline x 0.006 EIIP. Volume VIII: Chapt. 5. March 2005.

⁷⁷ Number of gas storage compressor stations = miles of transmission pipeline x 0.0015 EIIP. Volume VIII: Chapt. 5. March 2005.

⁷⁸ Northwest Pipeline Corporation Filing with Federal Energy Regulatory Committee Issued July 31, 2006 Accessed at <http://www.ferc.gov/eventcalendar/Files/20060731183500-RP06-416-000.pdf>

⁷⁹ Based on US DOE regional projections and electric sector growth assumptions (see Appendix A and B).

⁸⁰ Gas Facts reported unprotected and protected steel services for 2002, but only total services for other years. Therefore the ratio of unprotected and protected steel services in 2002 was assumed to be the ratio for all other years (0.4891 for protected services and 0.0045 for unprotected services). This yields more congruent results than the EIIP guidance of using multipliers of 0.2841 for protected steel services, and 0.0879 for unprotected steel services.

⁸¹ Refining assumed to be equal to the total input of crude oil into PADD V times the ratio of Washington's refining capacity to PADD V's total refining capacity. No data for 1995 and 1997, so linear relationship assumed from previous and subsequent years.

⁸² Based on EIA data, average growth in crude refined annually was 1.6% between 2000 and 2004.

Note that potential emission reduction improvements to pipeline technologies have not been accounted for in this analysis.

Coal Production Emissions

Methane occurs naturally in coal seams, and is typically vented during mining operations for safety reasons. Coal mine methane emissions are usually considerably higher, per unit of coal produced, from underground mining than from surface mining.

As reported by the EIA, Washington's only operating coal mine was TransAlta's Centralia open pit mine, which produced 5.3 million short tons in 2005.⁸³ In late 2006, TransAlta stopped mining operations at the Centralia mine, citing that out-of-state coal had become a more economic source of coal for the Centralia power plants.⁸⁴ However, Trans Alta is applying for permits to open new coal field in the near future.⁸⁵

In this inventory, methane emissions from coal mines are as reported by the EPA, and include emissions from the surface mine and post-mining activities.⁸⁶ As a result of the Centralia mine closure and current lack of permits for new coal developments, future emissions of coal mine methane were estimated to decrease to zero in 2007 and remain at that level through 2020. Note that any methane emissions from abandoned coal mines are not included in this inventory, as the EPA's emission inventory for abandoned coal mines does not include surface mines and does not report any methane emissions from abandoned Washington coal mines.⁸⁷ Any input from TWG members is welcomed.

Results

Figure E1 displays the methane emissions from coal mining and natural gas and oil systems, on a CO₂ equivalent basis. Emissions from this sector doubled from 1990 to 2005 and are projected to increase by a further 13% from 2005 to 2020. Natural gas transmission and distribution systems are the major contributors to historic fugitive GHG emissions, with natural gas distribution driving future emissions growth for this sector. While the Centralia mine closure reduced projected coal mine methane emissions, historically, total emissions from coal mining have been small compared with the natural gas industry.

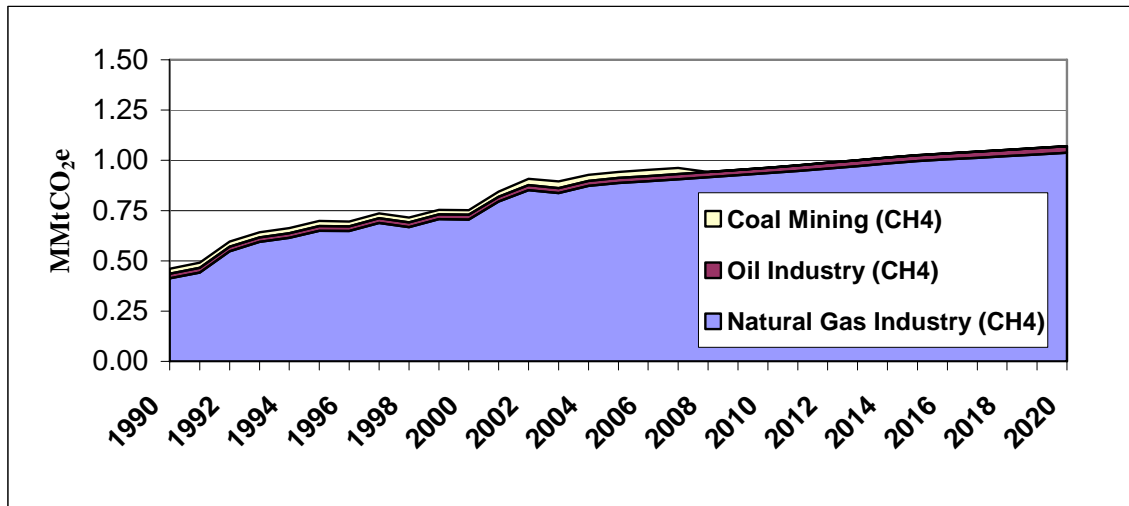
⁸³ EIA Annual Coal Report 2005 Accessed at http://www.eia.doe.gov/cneaf/coal/page/acr/acr_sum.html#fes1

⁸⁴ TransAlta press release, "TransAlta stops mine operations at Centralia, switches to Powder River Basin coal, and announces intention to write-down Centralia gas-fired plant", November 27, 2006, accessed at www.transalta.com.

⁸⁵ Personal Communication. Al Newman, WA Air Quality Program, Department of Ecology. April 2007.

⁸⁶ Emissions from EPA *Inventory of Greenhouse Gas Emissions and Sinks: 1990-2004* (April 2006) <http://yosemite.epa.gov/oar/globalwarming.nsf/content/ResourceCenterPublicationsGHGEmissionsUSEmissionsInventory2006.html>

⁸⁷ US EPA, "Methane Emissions from Abandoned Coal Mines in the United States: Emission inventory methodology and 1990-2002 emissions estimates", April 2004. Note that this inventory does not include emissions data for abandoned surface mines.

Figure E1. Fossil Fuel Industry Emission Trends (Million metric tons CO₂e)

Key Uncertainties

Key sources of uncertainty underlying the estimates above are as follows:

- Current levels of fugitive emissions. These are based on industry-wide averages, and until estimates are available for local facilities significant uncertainties remain.
- Projections of future processing, or any production, of fossil fuels in the State. These industries are difficult to forecast with the mix of drivers: economics, resource supply, demand, and regulatory procedures. The assumptions used for the projections do not include any significant changes in energy prices, relative to today's prices. Large price swings, resource limitations, or changes in regulations could significantly change future processing and the associated GHG emissions. New government policy could also lead to changes in production, such as future coal-bed methane production as part of geologic sequestration of CO₂ by point sources.
- Other uncertainties include any methane emissions from abandoned coal mines in Washington and potential emission reduction improvements to processing, transportation, and pipeline technologies.

Appendix F. Agriculture

Overview

The emissions discussed in this appendix refer to non-energy methane (CH₄) and nitrous oxide (N₂O) emissions from enteric fermentation, manure management, and agricultural soils. Emissions and sinks of carbon in agricultural soils are also covered. Energy emissions related to agricultural practices (combustion of fossil fuels to power agricultural equipment) are included in the residential, commercial, and industrial (RCI) fuel consumption sector estimates.

There are two livestock sources of GHG emissions: enteric fermentation and manure management. Methane emissions from enteric fermentation are the result of normal digestive processes in ruminant and non-ruminant livestock. Microbes in the animal digestive system breakdown food and emit CH₄ as a by-product. More CH₄ is produced in ruminant livestock because of digestive activity in the large fore-stomach. Methane and N₂O emissions from the storage and treatment of livestock manure (e.g., in compost piles or anaerobic treatment lagoons) occur as a result of manure decomposition. The environmental conditions of decomposition drive the relative magnitude of emissions. In general, the more anaerobic the conditions are, the more CH₄ is produced because decomposition is aided by CH₄ producing bacteria that thrive in oxygen-limited aerobic conditions. Under aerobic conditions, N₂O emissions are dominant. Emissions estimates from manure management are based on manure that is stored and treated on livestock operations. Emissions from manure that is applied to agricultural soils as an amendment or deposited directly to pasture and grazing land by grazing animals are accounted for in the agricultural soils emissions.

The management of agricultural soils can result in N₂O emissions and net fluxes of CO₂ causing emissions or sinks. In general, soil amendments that add nitrogen to soils can also result in N₂O emissions. Nitrogen additions drive underlying soil nitrification and de-nitrification cycles, which produce N₂O as a by-product. The emissions estimation methodologies used in this inventory account for several sources of N₂O emissions from agricultural soils, including decomposition of crop residues, synthetic and organic fertilizer application, manure application, sewage sludge, nitrogen fixation, and histosols (high organic soils, such as wetlands or peatlands) cultivation. Both direct and indirect emissions of N₂O occur from the application of manure, fertilizer, and sewage sludge to agricultural soils. Direct emissions occur at the site of application and indirect emissions occur when nitrogen leaches to groundwater or in surface runoff and is transported off-site before entering the nitrification/denitrification cycle. Methane and N₂O emissions also result when crop residues are burned. Methane emissions occur during rice cultivation; however, rice is not grown in Washington.

The net flux of CO₂ in agricultural soils depends on the balance of carbon losses from management practices and gains from organic matter inputs to the soil. Carbon dioxide is absorbed by plants through photosynthesis and ultimately becomes the carbon source for organic matter inputs to agricultural soils. When inputs are greater than losses, the soil accumulates carbon and there is a net sink of CO₂ into agricultural soils. In addition, soil disturbance from the cultivation of histosols releases large stores of carbon from the soil to the atmosphere. Finally, the practice of adding limestone and dolomite to agricultural soils results in CO₂ emissions.

Data Sources and Approach

Methane and Nitrous Oxide

GHG emissions for 1990 through 2005 were estimated using SGIT and the methods provided in the Emission Inventory Improvement Program (EIIP) guidance document for the sector.⁸⁸ In general, the SGIT methodology applies emission factors developed for the US to activity data for the agriculture sector. Activity data include livestock population statistics, amounts of fertilizer applied to crops, and trends in manure management practices. This methodology is based on international guidelines developed by sector experts for preparing GHG emissions inventories.⁸⁹

Data on crop production in Washington from 1990 to 2005 and the number of animals in the state from 1990 to 2002 were obtained from the United States Department of Agriculture (USDA), National Agriculture Statistical Service (NASS) and incorporated as defaults in SGIT.⁹⁰ Future reference case emissions from enteric fermentation and manure management were estimated based on the annual growth rate in emissions (million metric ton [MMt] carbon dioxide equivalent [CO₂e] basis) associated with historical livestock populations in Washington for 1990 to 2002. The default data in SGIT accounting for the percentage of each livestock category using each type of manure management system was used for this inventory. Default SGIT assumptions were available for 1990 through 2002.

Data on fertilizer usage came from *Commercial Fertilizers*, a report from the Fertilizer Institute. Data on crop production in Washington from 1990 to 2005 from the USDA NASS were used to calculate N₂O emissions from crop residues and crops that use nitrogen (i.e., nitrogen fixation) and CH₄ emissions from agricultural residue burning through 2005. Emissions for the other agricultural crop production categories (i.e., synthetic and organic fertilizers) were calculated through 2002.

Data were not available to estimate nitrogen released by the cultivation of histosols (i.e., the number of acres of high organic content soils). As discussed in the following section for soil carbon, the Natural Resources Ecology Laboratory at Colorado State University estimated 0.22 MMtCO₂ of emissions from cultivated high organic content soils in Washington for 1997. Therefore, future work should attempt to obtain data to estimate N₂O emissions from cultivated histosol soils in Washington to improve the emission estimates for this category.

Agricultural residue burning is conducted in Washington. The SGIT methodology calculates emissions by multiplying the amount (e.g., bushels or tons) of each crop produced by a series of

⁸⁸ GHG emissions were calculated using SGIT, with reference to Emission Inventory Improvement Program, Volume VIII: Chapter 8. "Methods for Estimating Greenhouse Gas Emissions from Livestock Manure Management", August 2004; Chapter 10. "Methods for Estimating Greenhouse Gas Emissions from Agricultural Soil Management", August 2004; and Chapter 11. "Methods for Estimating Greenhouse Gas Emissions from Field Burning of Agricultural Residues", August 2004.

⁸⁹ Revised 1996 Intergovernmental Panel on Climate Change Guidelines for National Greenhouse Gas Inventories, published by the National Greenhouse Gas Inventory Program of the IPCC, available at (<http://www.ipcc-nggip.iges.or.jp/public/gl/invs1.htm>); and Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, published in 2000 by the National Greenhouse Gas Inventory Program of the IPCC, available at: (<http://www.ipcc-nggip.iges.or.jp/public/gp/english/>).

⁹⁰ USDA, NASS (http://www.nass.usda.gov/Statistics_by_State/Washington/index.asp).

factors to calculate the amount of crop residue produced and burned, the resultant dry matter, and the carbon/nitrogen content of the dry matter. For Washington, the default SGIT activity data were used to calculate emissions because state-specific activity data in the form used in the SGIT were not readily available. Future work on this category should include an assessment to refine the SGIT default assumptions.

Table F1 shows the annual growth rates applied to estimate the reference case projections for the agricultural sector. Emissions from enteric fermentation and agricultural soils were projected based on the annual growth rate in historical emissions (MMtCO₂e basis) for these categories in Washington for 1990 to 2002 (1990 to 2005 for crop residues and nitrogen fixing crops).

Table F1. Growth Rates Applied for the Agricultural Sector

Agricultural Category	Growth Rate	Basis for Annual Growth Rate*
Enteric Fermentation	-1.3%	Historical emissions for 1990-2002.
Manure Management	1.7%	Historical emissions for 1990-2002.
Agricultural Burning	0.0%	Assumed no growth.
Agricultural Soils – Direct Emissions		
Fertilizers	-3.1%	Historical emissions for 1990-2002.
Crop Residues	0.3%	Historical emissions for 1990-2005.
Nitrogen-Fixing Crops	1.5%	Historical emissions for 1990-2005.
Histosols	0.0%	No historical data available.
Livestock	-2.2%	Historical emissions for 1990-2002.
Agricultural Soils – Indirect Emissions		
Fertilizers	-3.1%	Historical emissions for 1990-2002.
Livestock	-1.2%	Historical emissions for 1990-2002.
Leaching/Runoff	-2.4%	Historical emissions for 1990-2002.

* Compound annual growth rates shown in this table were calculated using the growth rate in historical emissions (MMtCO₂e basis) from 1990 through the most recent year of data. These growth rates were applied to forecast emissions from the latest year of data to 2020.

Soil Carbon

Net carbon fluxes from agricultural soils have been estimated by researchers at the Natural Resources Ecology Laboratory at Colorado State University and are reported in the US Inventory of Greenhouse Gas Emissions and Sinks⁹¹ and the US Agriculture and Forestry Greenhouse Gas Inventory. The estimates are based on the IPCC methodology for soil carbon adapted to conditions in the US. Preliminary state-level estimates of CO₂ fluxes from mineral soils and emissions from the cultivation of organic soils were reported in the US Agriculture and Forestry Greenhouse Gas Inventory.⁷ Currently, these are the best available data at the state-level for this category. The inventory did not report state-level estimates of CO₂ emissions from limestone and dolomite applications; hence, this source is not included in this inventory at present.

Carbon dioxide fluxes resulting from specific management practices were reported. These practices include: conversions of cropland resulting in either higher or lower soil carbon levels; additions of manure; participation in the Federal Conservation Reserve Program (CRP); and cultivation of organic soils (with high organic carbon levels). For Washington, Table F2 shows a

⁹¹ US Inventory of Greenhouse Gas Emissions and Sinks: 1990-2004 (and earlier editions), US Environmental Protection Agency, Report # 430-R-06-002, April 2006. Available at: <http://www.epa.gov/climatechange/emissions/usinventoryreport.html>.

summary of the latest estimates available from the USDA, which are for 1997.⁹² These data show that changes in agricultural practices are estimated to result in a net sink of 1.4 MMtCO₂e/yr in Washington. Since data are not yet available from USDA to make a determination of whether the emissions are increasing or decreasing, the net sink of 1.4 MMtCO₂e/yr is assumed to remain constant.

Table F2. GHG Emissions from Soil Carbon Changes Due to Cultivation Practices (MMtCO₂e)

Changes in cropland			Changes in Hayland				Other			Total ⁴
Plowout of grassland to annual cropland ¹	Cropland management	Other cropland ²	Cropland converted to hayland ³	Hayland management	Cropland converted to grazing land ³	Grazing land management	CRP	Manure application	Cultivation of organic soils	Net soil carbon emissions
0.51	(0.15)	(0.11)	(0.51)	(0.04)	(0.18)	(0.07)	(0.81)	(0.27)	0.22	(1.4)

Based on USDA 1997 estimates. Parentheses indicate net sequestration.

¹ Losses from annual cropping systems due to plow-out of pastures, rangeland, hayland, set-aside lands, and perennial/horticultural cropland (annual cropping systems on mineral soils, e.g., corn, soybean, cotton, and wheat).

² Perennial/horticultural cropland and rice cultivation.

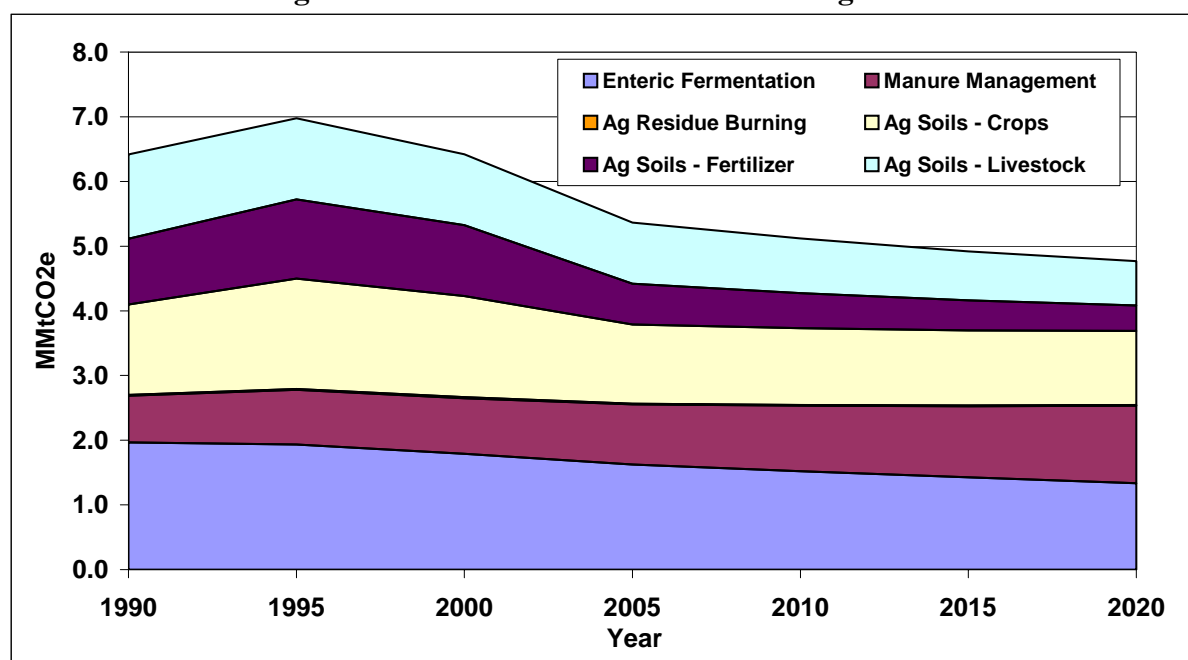
³ Gains in soil carbon sequestration due to land conversions from annual cropland into hay or grazing land.

⁴ Total does not include change in soil organic carbon storage on federal lands, including those that were previously under private ownership, and does not include carbon storage due to sewage sludge applications.

Results

As shown in Figure F1, gross GHG emissions from agricultural sources range between about 6.4 and 4.8 MMtCO₂e from 1990 through 2020, respectively. In 1990, enteric fermentation accounted for about 31% (1.96 MMtCO₂e) of total agricultural emissions and is estimated to decline to about 28% (1.33 MMtCO₂e) of total agricultural emissions in 2020. The manure management category, which shows the highest rate of growth relative to the other categories, accounted for 11% (0.72 MMtCO₂e) of total agricultural emissions in 1990 and is estimated to account for about 25% (1.2 MMtCO₂e) of total agricultural emissions in 2020. The agricultural soils category shows declining growth, with 1990 emissions accounting for 58% (3.72 MMtCO₂e) of total agricultural emissions and 2020 emissions estimated to be about 47% (2.22 MMtCO₂e) of total agricultural emissions. Including the CO₂ sequestration from soil carbon, the historic and projected emissions for the agriculture sector would range between about 5.0 and 3.4 MMtCO₂e/yr from 1990 through 2020, respectively. Livestock populations for beef and dairy cattle and swine in Washington have declined from 1995 through 2002 (the latest year for which SGIT data were available) resulting in the decline in historical emissions associated with the enteric fermentation, manure management, and agricultural soils livestock categories (see in Figure F1).

⁹² US Agriculture and Forestry Greenhouse Gas Inventory: 1990-2001. Global Change Program Office, Office of the Chief Economist, US Department of Agriculture. Technical Bulletin No. 1907, 164 pp. March 2004. http://www.usda.gov/oce/global_change/gg_inventory.htm; the data are in appendix B table B-11. The table contains two separate IPCC categories: “carbon stock fluxes in mineral soils” and “cultivation of organic soils.” The latter is shown in the second to last column of Table F2. The sum of the first nine columns is equivalent to the mineral soils category.

Figure F1. Gross GHG Emissions from Agriculture

Source: CCS calculations based on approach described in text.

Notes: Ag Soils – Crops category includes: incorporation of crop residues and nitrogen fixing crops (no cultivation of histosols estimated); emissions for agricultural residue burning are too small to be seen in this chart. Soil carbon sequestration is not shown (see Table F2).

For the manure management category, historical emission trends increase by an average annual rate of 1.7% while animal populations have declined (see Table F1). The increase in emissions associated with manure management is related to the default assumptions (that change from 1990 through 2002) used in EPA's SGIT on the types of manure management systems primarily for dairy cattle operations. For dairy cattle and heifers, the proportion of manure managed in systems that yield higher GHG emissions (e.g., anaerobic lagoons and liquid slurry) than other systems (e.g., pasture) increased from 68% for dairy cattle and 71% for dairy heifers in 1990, to 76% for dairy cattle and 77% for dairy heifers for 1997 through 2002. For swine operations, from 1990 through 2002, the default SGIT assumptions include a 2% change toward the use of manure management systems that yield higher GHG emissions relative to other systems. Note that for beef cattle, the SGIT uses the same distribution of manure management systems for 1990 through 2002.

Agricultural burning emissions were estimated to be relatively large for Washington based on the SGIT activity data (about 0.01 MMtCO₂e/yr from 1990 to 2002). For Washington, this category accounts for about 0.2% of total gross GHG emissions associated with the agricultural sector. Emissions for this category account for about one-half of the national emissions included in the USDA Inventory, which relative to other agricultural categories, reports a low level of residue burning emissions (0.02 MMtCO₂e). Even though these initial emission estimates using the SGIT are low relative to emissions associated with the other agricultural categories in Washington, the emission estimates for agricultural burning in Washington are highly uncertain using the SGIT methodology and should be refined using actual activity data for Washington, if available.

The only standard IPCC source categories missing from this report are CO₂ emissions from limestone and dolomite application, and N₂O emissions from the cultivation of histosol soils (discussed above). Estimates for CO₂ emissions from limestone and dolomite for Washington were not available; however, the USDA's national estimate is about 9 MMtCO₂e/yr.⁹³

Key Uncertainties

Emissions from enteric fermentation and manure management are dependent on the estimates of animal populations and the various factors used to estimate emissions for each animal type and manure management system (i.e., emission factors which are derived from several variables including manure production levels, volatile solids content, and CH₄ formation potential). Each of these factors has some level of uncertainty. Also, animal populations fluctuate throughout the year, and thus using point estimates introduces uncertainty into the average annual estimates of these populations. In addition, there is uncertainty associated with the original population survey methods employed by USDA. The largest contributors to uncertainty in emissions from manure management are the emission factors, which are derived from limited data sets.

As mentioned above, for emissions associated with changes in agricultural soil carbon levels, the only data currently available are for 1997. When newer data are released by the USDA, these should be reviewed to represent current conditions as well as to assess trends. In particular, given the potential for some CRP acreage to retire and possibly return to active cultivation prior to 2020, the current size of the CO₂ sink could be appreciably affected. As mentioned above, emission estimates for soil liming have not been developed for Washington.

An additional issue related to changes in terrestrial carbon potentially resulting in CO₂ emissions is that of land conversion from agricultural cover to urbanized use. Agricultural cover includes pasturelands, rangelands, croplands, and CRP lands. Data that would yield sufficient information to examine the carbon impact of the conversion of these lands to urbanized development are available (e.g. soil carbon losses due to different types of land development). Therefore, CCS did not develop estimates of GHG emissions related to changes in land cover, in particular agricultural land conversion to urbanized use.

Another contributor to the uncertainty in the emission estimates is the projection assumptions. This inventory assumes that the average annual rate of change in future year emissions will follow the historical average annual rate of change from 1990 through the most recent year of data. For example, the historical data show a decline in the use of fertilizers; however, there may be a leveling-off in fertilizer use trends due to recent efficiency gains that may be close to reaching their full technical potential.

Although the agricultural burning emissions estimated using the SGIT method are low relative to emissions associated with the other agricultural categories covered by this sector, the emissions account for about one-half of the US total estimated for this category. Future work on the agricultural sector should include efforts to improve the estimates for agricultural burning.

⁹³ US Agriculture and Forestry Greenhouse Gas Inventory: 1990-2001. Global Change Program Office, Office of the Chief Economist, US Department of Agriculture.

Appendix G. Waste Management

Overview

GHG emissions from waste management include:

- Solid waste management – CH₄ emissions from municipal and industrial solid waste landfills (LFs), accounting for CH₄ that is flared or captured for energy production (this includes both open and closed landfills);
- Solid waste combustion – CH₄, CO₂, and N₂O emissions from the controlled combustion of solid waste in incinerators or waste to energy plants; also uncontrolled combustion, also referred to as open burning of waste (e.g. in residential burn barrels) ; and
- Wastewater management – CH₄ and N₂O from municipal wastewater and CH₄ from industrial wastewater (WW) treatment facilities.

Municipal solid waste (MSW), a category of solid waste generated by households and commercial businesses, consists primarily of durable and non-durable goods, packaging, food waste and yard trimmings. The greenhouse gas impact of MSW is dependent on the composition and quantity of waste generated; the waste management strategy such as combustion, recycling or disposing in landfills; landfill characteristics; and the existence of methane flaring or energy conversion technology.⁹⁴

In the MSW sector, this inventory and forecast captures emissions for landfill activities that occur within the State. It is important to note that this does not capture some waste that is imported from other States. For example, some waste is imported from other States and put in the landfill at the Roosevelt landfill in eastern WA. Ecology estimates that about 200,000 to 275,000 tons of waste from out-of-State sources are placed in WA landfills annually with more than half of this going into the Roosevelt landfill.⁹⁵ This represents about 5% of the total 2005 landfill waste in the State.

This inventory and forecast does not capture waste that is exported for disposal in other States. For example, the City of Seattle has exported waste to a disposal site in Arlington, Oregon since 1991. Data were not identified to capture the GHG emissions associated with exported waste.

Inventory and Reference Case Projections

Solid Waste Management

Landfills. For municipal solid waste landfills, we used the U.S. EPA SGIT and data on waste emplacement at WA landfills from Ecology⁹⁶ as starting points to estimate emissions. The Ecology data served as input data to estimate annual waste emplacement needed by SGIT. SGIT

⁹⁴ *Solid Waste Management and Greenhouse Gases, A Life Cycle Assessment of Emissions and Sinks*, US EPA, pg ES-6; <http://www.epa.gov/climatechange/wywd/waste/SWMGHGreport.html>, September 2006.

⁹⁵ Washington State, Department of Ecology, *Solid Waste in Washington State, Fifteenth Annual Status Report*, 2006, p. 96.

⁹⁶ Washington State, Department of Ecology, *Solid Waste in Washington State, Fifteenth Annual Status Report*, 2006.

then estimates CH₄ generation for each landfill site using a commonly-employed first order waste decomposition model (e.g. as in EPA's AP-42 document).⁹⁷ Additional post-processing outside of SGIT to account for controls was then performed to estimate CH₄ emissions.

The data provided by Ecology contained annual waste emplacement data from 1992 to 2005 for three categories of landfills: controlled landfills with a landfill gas to energy (LFGTE) plant; controlled landfills with a flare; and uncontrolled landfills. Since SGIT requires emplacement data back to at least 1990, the missing years of data for each site were filled in using the average annual emplacement from 1992-1994.

There were a total of 29 sites in the Ecology database plus another 20 miscellaneous landfills that were small uncontrolled sites that were closed in the early 1990s or earlier. Eight of the sites collect landfill gas for use in an LFGTE plant. Another seven sites collect and flare landfill gas. These 15 sites are listed in the table below. The remaining 14 sites are uncontrolled.

Site Name	Control
Roosevelt Regional LF	LFGTE
Cedar Hills LF	LFGTE
Hidden Valley LF	LFGTE
Olympic View LF	LFGTE
Northside LF	LFGTE ^a
Tacoma LF	LFGTE
Cowlitz County LF	LFGTE
Centralia LF	LFGTE
Cathcart LF	Flare
Greater Wenatchee LF	Flare
Thurston Co.	Flare
Terrace Heights	Flare
Cheyne	Flare
Leichner	Flare
Fort Lewis	Flare

^a Closed in 2005.

CCS performed three different runs of SGIT to estimate methane emissions from MSW landfills: (1) uncontrolled landfills; (2) landfills with a landfill gas collection system and LFGTE plant; and (3) landfills with landfill gas collection and a flare. SGIT produced annual estimates through 2005 for each of these landfill categories. CCS then performed some post-processing of the landfill emissions to account for landfill gas controls (at LFGTE and flared sites) and to project the emissions through 2020. For the controlled landfills, CCS assumed that the overall methane collection and control efficiency is 75%.⁹⁸ Of the methane not captured by a landfill gas collection system, it is further assumed that 10% is oxidized before being emitted to the atmosphere (consistent with the SGIT default assumption).

⁹⁷ EPA's AP-42 Section covering Municipal Solid Waste Landfills can be found at: <http://www.epa.gov/ttn/chief/ap42/ch02/final/c02s04.pdf>.

⁹⁸ As per EPA's AP-42 Section on Municipal Solid Waste Landfills: <http://www.epa.gov/ttn/chief/ap42/ch02/final/c02s04.pdf>.

Growth rates were estimated by using the historic (1995-2005) growth rates of emissions in both the controlled and uncontrolled landfill categories. The period from 1995 to 2005 was used since there were a large number of landfill closures prior to 1995 (which could have affected waste management practices). Hence, the post-1995 period is thought to be most representative of waste emplacement rates and subsequent emissions. The annual growth rates are: 3.5% for uncontrolled sites; 1.1% for flared sites; and 3.2% for LFGTE landfills.

CCS used the SGIT default for industrial landfills. Based on estimates of the quantity of waste in place at industrial landfills and on the estimated organic content of industrial landfills compared to MSW landfills, U.S. EPA (1993) estimated that CH₄ generation from industrial landfills in the United States is approximately 7 percent of CH₄ generation from MSW landfills in the United States, prior to adjusting for flaring and recovery or oxidation.⁹⁹ We assumed that this additional industrial waste emplacement occurs beyond that already addressed in the emplacement rates for MSW sites. Due to a lack of data, no controls were assumed for industrial landfill waste. For industrial landfills, the overall growth rate in MSW emissions from 1995 to 2005 was 2.9%/yr, which was used to project emissions to 2010 and 2020.

Solid Waste Combustion. Ecology provided throughput data for the only municipal waste combustion facility currently operating in WA (Spokane).¹⁰⁰ SGIT defaults (emission factors, waste characteristics) were used to estimate emissions using these data. Data on other waste combustion facilities that previously operated in WA were not available. No information was identified on plans for additional plants in the future or expanded capacity at the existing plant, so emissions were held constant in the forecast years.

Open burning of MSW at residential or municipal sites can also contribute GHG emissions. If data are available, future inventory work should attempt to capture this source of emissions.

Wastewater Management

Municipal Wastewater Management. For municipal wastewater treatment, emissions are calculated in EPA's SGIT based on state population, assumed biochemical oxygen demand (BOD) and protein consumption per capita, and emission factors for N₂O and CH₄. The key SGIT default values are shown in Table G1 below. The growth rate for municipal wastewater treatment used to forecast emissions from 2005 to 2020 is 2.1%/yr. This is based on the historical emissions growth between 1990 and 2005.

⁹⁹ EIIP Volume VIII, Chapter 13 – Municipal Solid Waste, August 2004.

¹⁰⁰ Gail Sandlin, Ecology, personal communication with S. Roe, CCS, May 2007.

Table G1. SGIT Key Default Values for Municipal Wastewater Treatment

Variable	Value
BOD	0.065 kg /day-person
Amount of BOD anaerobically treated	16.25%
CH ₄ emission factor	0.6 kg/kg BOD
WA residents not on septic	75%
Water treatment N ₂ O emission factor	4.0 g N ₂ O/person-yr
Biosolids emission Factor	0.01 kg N ₂ O-N/kg sewage-N
Source: U.S. EPA State Inventory Tool – Wastewater Module; methodology and factors taken from U.S. EPA, Emission Inventory Improvement Program, Volume 8, Chapter 12, October 1999: www.epa.gov/ttn/chiep/eiip/techreport/volume08/ .	

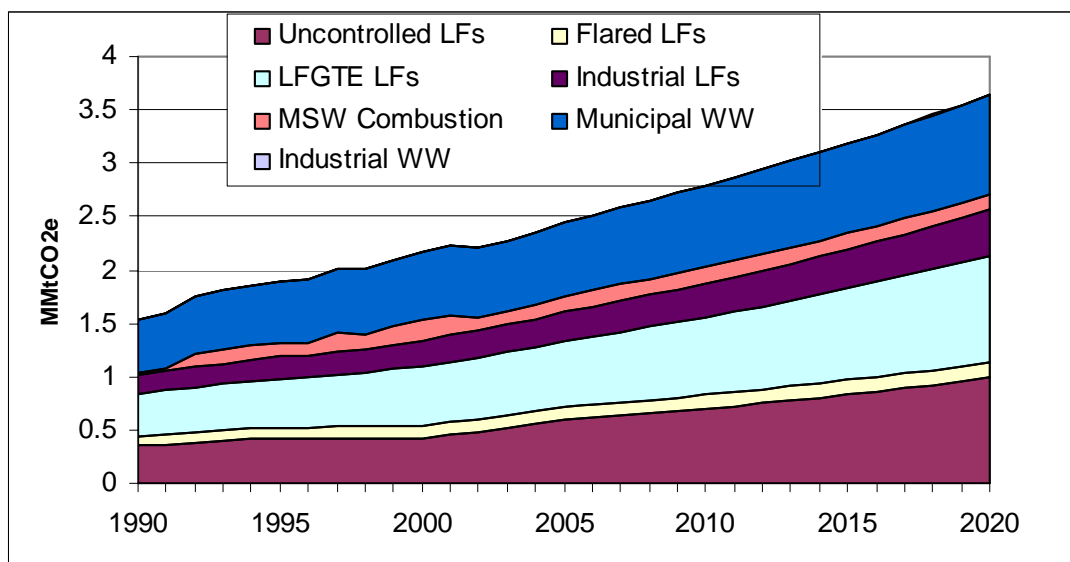
Industrial Wastewater Management. For industrial wastewater emissions, SGIT provides default assumptions and emission factors for three industrial sectors: Fruits & Vegetables, Red Meat & Poultry, and Pulp & Paper. Ecology was able to provide information on flows and chemical oxygen demand (COD) for fruit and vegetable processing, but only COD for the other two categories.¹⁰¹ Therefore, only emissions from fruit and vegetable processing were estimated. The data on annual wastewater flows from Ecology were used to back-calculate an annual production value using SGIT data (3.8 cubic meters of wastewater for every ton processed). Due to incomplete data for all years, the calculated production value was used for each year of the inventory and forecast.

Results

Figure G1 shows the emission estimates for the waste management sector. Overall, the sector accounts for 2.4 MMtCO₂e in 2005. By 2020, emissions are expected to increase to 3.6 MMtCO₂e/yr. For solid waste management sector, emissions are expected to increase as a result of more waste being emplaced in each of the landfill categories. In 1990, about 23% of the waste management sector emissions were contributed by the uncontrolled landfills; and about 25% by LFGTE landfills. By 2020, the contributions from these landfill categories are expected to rise slightly 27% and 28%, respectively.

As mentioned above, due to data availability, we modeled only emissions from fruit and vegetable processors in the industrial wastewater treatment sector (and these emissions were held constant at 2005 levels throughout the inventory and forecast). Less than 0.1% of the emissions were contributed by the industrial wastewater treatment sector. In 2005, 28% of the waste management sector emissions were contributed from municipal wastewater treatment systems. Note that these estimates are based on the default parameters listed in Table G1 above and might not adequately account for existing controls (e.g. anaerobic digesters served by a flare or other combustion device). By 2020, municipal wastewater treatment is expected to contribute about 26% of the waste management sector emissions.

¹⁰¹ Carrol Johnston, Ecology, personal communication with S. Roe, CCS, December 2006. The average COD for fruit and vegetable processors at the monitoring point listed as “process wastewater” was 3.8 grams/liter compared to the SGIT default of 5.6 grams/liter. This value was used within SGIT to estimate methane emissions. Process wastewater flow data were available for 1995, 2000, and 2005; however, the 2005 data appeared to be most complete. For seven fruit and vegetable processing facilities, an annual flow of 369 million gallons was estimated and used as input for all years.

Figure G1. Washington GHG Emissions from Waste Management

Notes: LF – landfill; WW – wastewater; LFGTE – landfill gas to energy. Industrial WW is too small to show on this chart.

Key Uncertainties

The methods used to model landfill gas emissions do not adequately account for the points in time when controls were applied at individual sites. Hence, for landfills, the historical emissions are less certain than current emissions and future emissions for this reason (since each site that is currently controlled was modeled as always being controlled, the historic emissions are low as a result). The modeling also does not account for uncontrolled sites that will need to apply controls during the period of analysis due to triggering requirements of the federal New Source Performance Standards/Emission Guidelines. Similarly, the modeling does not account for sites that are currently flared, but may opt to incorporate LFGTE during the period of analysis.

As mentioned above, these estimates for MSW landfills do not capture emissions associated with waste that is generated in the State but exported for disposal elsewhere. Also, some importing of waste for landfilling occurs, and these emissions are also not captured in this analysis. Future work should include gathering information on the amounts of waste imported/exported and the methods of disposal, so that emissions can be estimated.

For industrial landfills, these were estimated using national defaults (7% of the rate of MSW methane generation). Hence, the industrial landfill inventory and forecast has a significant level of uncertainty and should be investigated further. For example, the existence of active industrial landfills should be determined, available emissions data assessed, or modeling performed based on waste characteristics (based on the biodegradable fraction of the waste). As with overall MSW landfill emissions, industrial landfill emissions are projected to increase slightly between 2005 and 2020.

For the wastewater sector, the key uncertainties are associated with the application of SGIT default values for the parameters listed in Table G1 above (e.g. fraction of the WA population on septic; fraction of BOD which is anaerobically decomposed). The SGIT defaults were derived from national data. Also, data were not available to estimate emissions from the meat & poultry and pulp & paper industry sectors. Based on the rough estimates prepared for fruit and vegetables, CCS anticipates that the contributions from the industrial wastewater treatment sector would be fairly low.

Appendix H. Forestry

Overview

Forestland emissions refer to the net CO₂ flux¹⁰² from forested lands in Washington, which account for about 48% of the state's land area.¹⁰³ The dominant forest types in WA are Douglas fir forests, which make up about 38% of forested lands and Hemlock-Sitka spruce forests which make up another 23%. Other important forest types are Ponderosa pine, Fir-Spruce, and hardwood forests.

Forestlands are net sinks of CO₂ in Washington. Through photosynthesis, carbon dioxide is taken up by trees and plants and converted to carbon in biomass within the forests. Carbon dioxide emissions occur from respiration in live trees, decay of dead biomass, and fires. In addition, carbon is stored for long time periods when forest biomass is harvested for use in durable wood products. CO₂ flux is the net balance of carbon dioxide removals from and emissions to the atmosphere from the processes described above.

Inventory and Reference Case Projections

For over a decade, the United States Department of Agriculture Forest Service (USDA-FS) has been developing and refining a forest carbon modeling system for the purposes of estimating forest carbon inventories. The methodology is used to develop national forest CO₂ fluxes for the official US Inventory of Greenhouse Gas Emissions and Sinks.¹⁰⁴ The national estimates are compiled from state-level data. The Washington forest CO₂ flux data in this report come from the national analysis and are provided by USDA-FS.

The forest CO₂ flux methodology relies on input data in the form of plot level forest area and volume statistics from the Forest Inventory Analysis (FIA). FIA data on forest volumes are converted to values for ecosystem carbon stocks (i.e., the amount of carbon stored in forest carbon pools) using the FORCARB2 modeling system. Coefficients from FORCARB2 are applied to the plot level tree measurements to give estimates of C density (Mg per hectare) for the tree carbon pool. The carbon content of other pools is estimated using relationships between tree carbon and those pools. Soil carbon is estimated as a function of forest cover type. Detailed descriptions of the FORCARB2 modeling system can be found in current versions of the U.S. Inventory of Greenhouse Gas Emissions and Sinks.

CO₂ flux is estimated as the change in carbon stock for each carbon pool over a specified time frame. Forest carbon stock data from at least two points in time are required to calculate flux. The change in carbon stocks between time intervals is estimated for specific carbon pools (Live Tree, Standing Dead Wood, Understory, Down & Dead Wood, Forest Floor, and Soil Organic

¹⁰² "Flux" refers to both emissions of CO₂ to the atmosphere and removal (sinks) of CO₂ from the atmosphere.

¹⁰³ Total forested acreage is 21.9 million acres. Acreage by forest type available from the USFS at: <http://www.fs.fed.us/ne/global/pubs/books/epa/states/WA.htm>. The total land area in WA is 45.6 million acres (<http://www.50states.com/Washington.htm>).

¹⁰⁴ U.S. Inventory of Greenhouse Gas Emissions and Sinks: 1990-2004 (and earlier editions), US Environmental Protection Agency, Report # 430-R-06-002, April 2006. Available at: <http://www.epa.gov/climatechange/emissions/usinventoryreport.html>.

Carbon) and divided by the number of years between inventory measurements. Annual increases in carbon stocks reflect carbon sequestration in a specific pool; decreases in carbon stocks reveal CO₂ emissions or carbon transfers out of that pool (e.g., death of a standing tree transfers carbon from the live tree to standing dead wood pool). The sum of carbon stock changes for all forest carbon pools yields a total net CO₂ flux for forest ecosystems. Personal communication with USDA-FS experts indicates a high degree of uncertainty in the soil carbon pool estimates; therefore this pool is not included in the total for Washington.

In addition to the forest carbon pools, additional carbon stored as biomass is removed from the forest for the production of durable wood products. Carbon remains stored in the products pool or is transferred to landfills where much of the carbon remains stored over a long period of time. As shown in Table H1, nearly 12 MMtCO₂/yr is estimated as sequestered annually in wood products from WA forests.¹⁰⁵ The USDA-FS models the amount of carbon moving into and remaining stored in the HWP products pool over time using the WOODCARB model. Additional details on the HWP model and other aspects of the forest carbon inventory methods can be found in Annex 3 to EPA's 2006 GHG inventory for the U.S.¹⁰⁶

Forest carbon stocks at any point in time are the product of forest carbon density and forest area. Thus, the combined impact of changes in both of these factors over a specified time period influences the total estimated net carbon flux. These factors vary to some degree by different ownership classes and major climatic regions. For this reason, the USDA-FS provided forest carbon estimates separately for the East- and West-sides of Washington and for National and non-National Forests (Tables H1, H2, and H3).

The data shown below are based on the most recent estimates from the USDA-FS and will be included in the upcoming 2005 estimates in EPA's national GHG inventory.

¹⁰⁵ Jim Smith, USFS, personal communication with S. Roe, CCS, October 2006.

¹⁰⁶ Annex 3 to EPA's 2006 report, which contains estimates for calendar year 2004, can be downloaded at: [http://yosemite.epa.gov/oar/globalwarming.nsf/UniqueKeyLookup/RAMR6MBLNQ/\\$File/06_annex_Chapter3.pdf](http://yosemite.epa.gov/oar/globalwarming.nsf/UniqueKeyLookup/RAMR6MBLNQ/$File/06_annex_Chapter3.pdf).

Table H1. Forest Carbon Flux Estimates for Washington (MMtCO₂e)

	Westside			Eastside			WA State Total
	National Forest	Non-National Forest	Westside Total	National Forest	Non-National Forest	Eastside Total	
Live Tree	-6.10	-5.98	-12.08	-5.29	5.31	0.01	-12.06
Standing dead	0.88	-0.38	0.50	-0.48	0.00	-0.48	0.02
Understory	-0.10	0.05	-0.05	-0.21	-0.14	-0.36	-0.41
Down dead	-0.79	-0.89	-1.68	-0.61	0.56	-0.04	-1.72
Forest floor	-0.07	-2.30	-2.37	-0.01	-0.35	-0.36	-2.73
Soil organic C	-3.02	-1.10	-4.12	-2.27	-1.39	-3.66	-7.79
HWP	na	na	na	na	na	na	-11.73
Total Forest C Flux (not including soil carbon)							-28.63

Negative values indicate sequestration; positive values indicate emissions

Totals may not sum exactly due to independent rounding.

Data source: Jim Smith, USFS, personal communications with S. Roe, CCS, October 2006 and February 2007 and with K. Bickel June 2007.

Discussion

Forest Area Trends

As noted above, changes in forest area influence total forest carbon flux in Washington State. Therefore, reliable estimates of forest area over time are an important input to any forest carbon methodology. The USDA-FS methodology relies on FIA data for forest areas, as shown in Table H2¹⁰⁷. FIA data indicate a net increase in forest area for Washington from 1991 to 2005.

Table H2. Forest Area Data (hectares) for 1991 and 2005 used to estimate Forest Carbon Stocks

	Westside			Eastside			WA State Total
	National Forest	Non-National Forest	Westside Total	National Forest	Non-National Forest	Eastside Total	
1991	1,371,667	3,588,209	4,959,876	1,831,120	2,025,402	3,856,522	8,816,398
2005	1,412,367	3,536,270	4,948,637	1,933,292	2,069,372	4,002,664	8,951,301
Change in Area	40,700	-51,939	-11,239	102,172	43,970	146,142	134,903

A look at finer temporal periods can reveal trends in forest land use change during this time frame that are not evident in the above data. For example, CCS queried the FIA database for total forest area in 2003, resulting in an estimated area of 8,742,746 hectares of forestland in

¹⁰⁷ National Forest lands are not included in the 1991 FIA database. The USFS used a data from the 1987 Resource Planning Assessment to estimate forest area and carbon flux on National Forests in 1991.

2003. Thus, according to FIA, forest areas declined in Washington from 1991 to 2003, and increased from 2003 to 2005, eventually surpassing 1991 levels. While finer scale land area change data are available, the total forest carbon estimates are only available for 1991 and 2005, thus the net flux calculated for this report reflects the average trends for this time period. Key uncertainties in the FIA forest sampling system are discussed in the Key Uncertainties section below.

Given the important role of forest area change in determining net carbon flux, relevant data from a recent study conducted by the University of Washington are reported here as well.¹⁰⁸ The UW study analyzed trends in forest area change using both FIA data from 1978-2001 and remote sensing data from 1988-2004. The study used FIA data to look at trends in non-National Forest timberlands (i.e., forests capable of growing more than 20 cubic feet of timber per year) from 1978-2001 across all of Washington, and concluded that land area in timberlands declined at a rate of 0.37% per year during this time. The report also used FIA data to analyze ownership trends for timberland classes and showed an overall trend of shifting ownership from traditional forest industry companies to private ownership classes, followed by the subsequent conversion of timberland in private ownership to non-forest uses. The remote sensing analysis covered western Washington only and revealed trends of net forest loss on the order of 1.04% per year from 1988-2004.

Forest Carbon Density Trends

Important differences in carbon density exist between Eastside and Westside forests, and also between National Forest and non-National Forest ownerships. The USDA-FS methodology accounts for this by separating the analysis of area change and carbon density change into four different categories (Table H3).

Table H3. Differences in 2005 forest C density between Eastside and Westside and across ownerships for Washington.

	C density (t C per ha)	
	in forest	trees only
Eastside		
National Forest	220.8	100.7
nonNational Forest	188.6	77.3
Westside		
National Forest	380.2	229.2
nonNational Forest	302.1	159.2
total	270.6	138.7

This analysis shows that average Westside forests of all ownerships have more than double the C density of average Eastside forests of all ownerships, and National Forest ownerships tend to have higher C density values than non-National Forest ownerships.

¹⁰⁸ Future of Washington's Forest and Forest Industries Study July 2007, Study 4: Forest Land Conversion in Washington State

Interannual Variability

The annual carbon flux for Washington forests calculated from inventory measurements reflects average annual trends over fourteen years. Of course, annual fluxes will vary from year to year. However, current available data and methodologies do not allow for analysis of inter-annual variability. Moreover, information is not currently available on the near term effects of climate change and their impacts on forest productivity, or on future rates of forest area change. Hence, there is no change in the estimated future sinks for 2010 and 2020.

Wildfire and Non-CO₂ Losses

The USDA-FS forest carbon methodology captures carbon stock losses from fires, but it does not address non-CO₂ emissions. In order to provide a more comprehensive understanding of GHG sources/sinks from the forestry sector, CCS also developed some rough estimates of state-wide emissions for methane and nitrous oxide from wildfires and prescribed burns. A study published earlier this year in *Science* indicated an increasing frequency of wildfire activity in the western U.S. driven by a longer fire season and higher temperatures.¹⁰⁹

CCS used 2002 emissions data developed by the Western Regional Air Partnership (WRAP) to estimate CO₂e emissions for wildfires and prescribed burns.¹¹⁰ The CO₂e from methane emissions from this study were added to an estimate of CO₂e for nitrous oxide to estimate a total CO₂e for fires. The nitrous oxide estimate was made assuming that N₂O was 1% of the emissions of nitrogen oxides (NO_x) from the WRAP study. The 1% estimate is a common rule of thumb for the N₂O content of NO_x from combustion sources.

The results for 2002 are that fires contributed about 0.28 MMtCO₂e of methane and nitrous oxide. Most of this was contributed by wildfires (0.14 MMtCO₂e) and agricultural burning (0.11 MMtCO₂e). In 2002, there were about 90,000 acres burned by wildfires and about 660,000 acres of agricultural burning. About 90% of the CO₂e was contributed by CH₄. Note that the 2002 level of wildfire activity compares to about 132,000 acres burned in Washington in 1996.¹¹¹ Also, in 2002, about two-thirds of the total fuel consumed came from agricultural burning.

A comparison estimate was made using emission factors from a 2001 global biomass burning study¹¹² and the total tons of biomass burned from the 2002 WRAP fires emissions inventory. This estimate is 0.63 MMtCO₂e with about equal contributions from methane and nitrous oxide on a CO₂e basis. Given the large swings in fire activity from year to year and the current lack of

¹⁰⁹ Westerling, A.L. et al, "Warming and Earlier Spring Increases Western U.S. Forest Wildfire Activity", *Scienceexpress*, July 6, 2006.

¹¹⁰ 2002 Fire Emission Inventory for the WRAP Region Phase II, prepared by Air Sciences, Inc. for the Western Regional Air Partnership, July 22, 2005. Ecology also provided activity data for agricultural and silvicultural burning to CCS. A review of the WRAP's report shows that data are included for WA covering the prescribed fire, agricultural burning, and prescribed rangeland burning categories. Therefore, the WA were not used to prepare any additional emission estimates.

¹¹¹ 1996 Fire Emission Inventory, Draft Final Report, prepared by Air Sciences, Inc. for the Western Regional Air Partnership, December 2002.

¹¹² M. O. Andreae and P. Merlet, "Emission of trace gases and aerosols from biomass burning", *Global Biogeochemical Cycles*, Vol. 15, No. 4, pp. 955-966, December 2001.

data for multiple years, CCS did not include these estimates in with the annual forestry flux estimates presented in the emissions summaries of this report. However, on the basis of total acres burned in 1996 and 2002, it appears that forest fires contribute on the order of 0.1 – 0.5 MMtCO₂e annually in WA from methane and nitrous oxide emissions.

Key Uncertainties

A key uncertainty in the forest carbon flux estimates is the comparability over time of the underlying forest area data. The FIA forest sampling program is developed to provide an unbiased representation of forest land area. FIA chooses an unbiased set of plots for field sampling in each inventory cycle, with the goal of representing the variety of forest conditions occurring on the ground at that time. It is widely believed to be the best available long-term data set on forest resources in the nation. However, conversations with national experts and local FIA personnel revealed that aspects of the FIA program and its evolution over time have resulted in potential sampling errors that can challenge long-term comparisons made from FIA data. These are described below to give an indication of the potential sources of error.

Nationwide, in the late 1990's and early 2000's FIA moved from a periodic to an annual sampling protocol; the annual sampling protocol was first implemented in Washington in 2001. The annualized protocol involves sampling a fraction of the total number of FIA plots in a state each year, so that 100% of the plots are inventoried every ten years. In Washington, this means that 400 plots are sampled each year for a total of 4,000+ plots in WA over the full inventory cycle. Each year, the inventory results are adjusted to incorporate new data that are collected that year.

After a full ten-year cycle is completed, the FIA will have sampled approximately one in 6,000 forested acres in Washington. In the initial years of the inventory cycle, relatively few plots have been sampled so the potential error in summarized results calculated from these data is relatively large. As new data are added to the database each year, the potential error in inventory-based results will decrease.

In this report, the 1991 FIA data are derived from the periodic sampling protocol, while the 2005 data are based on four years of sampling under the more recent annualized design (i.e., includes 40% of the total FIA plots). Therefore, the range of error around these forest carbon estimates is likely to be relatively wide. While a quantitative assessment of the error range for the forest carbon estimates reported here is not available, as with most inventory-based estimates of forest C stock change in North America, it is possible that the true value lies somewhere within 50% above or 50% below the estimate reported here.¹¹³ If these estimates were recalculated

¹¹³ Birdsey, R.A., J.C. Jenkins, M. Johnston, E. Huber-Sannwald, B. Amerio, B. de Jong, J.D.E. Barra, N. French, F. Garcia-Olivaria, M. Harmon, L.S. Heath, V. Jaramillo, K. Johnsen, B.E. Law, O. Masera, R. Neilson, Y. Pan, K.S. Pregitzer, E.M. Spiotta, 2007: North American forests, in *The First State of the Carbon Cycle Report (SOCCR): The North American Carbon Budget and Implications for the Global Carbon Cycle*. A.W. King, L. Dilling, G.P. Zimmerman, D.M. Fairman, R.A. Houghton, G. Marland, A.Z. Rose, T.J. Wilbanks, editors. A report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research, Washington, DC.

annually, the range of error would likely decrease until 2011 when the sampling of all FIA plots in Washington will be completed.

When sampling switched from the periodic to the annual inventory system, in WA as in other states, attempts were made to retain and re-sample plots that had been sampled previously in order to maintain a record that would allow for trend estimation. Attempts were also made to retain the unbiased nature of the sample, so there is no indication that a sampling bias has occurred in any forest type in the transition from periodic to annual inventory.

There have been modifications to the definition of forests for some specific forest classes. For example, FIA modified the definition of forest cover for the woodlands class of forestland. Earlier FIA cycles defined woodlands as having a tree cover of at least 10%, while the newer sampling methods used a woodlands definition of tree cover of at least 5% (leading to more area being defined as woodland). In woodland areas, the earlier FIA surveys might not have inventoried trees of certain species or with certain tree form characteristics (leading to differences in both carbon density and forested acreage). Given that woodlands do not make up much of Washington's forests, these methodological differences are not thought to have a substantial effect on the flux estimates.

For the specific case of newly established riparian areas (an area of potential interest in Washington), FIA's definition of "forest" includes contiguous land that is at least 1 acre in size and at least 50 feet wide. Therefore, if a narrow riparian buffer has been established in an area that was previously pasture or cropland, the FIA forest area sample will not reflect that increase in tree cover. If management activities have changed in existing riparian buffers, the effects of those changes will be reflected in the overall inventory, just as changes in any other management trends would be reflected in the overall inventory sample.

Also, FIA surveys since 1999 include all dead trees on the plots, but data prior to that are variable in terms of these data. As shown in Table H1, the standing dead and down/dead pools contribute about 7% of the total estimated forest flux. The modifications to FIA surveys are a result of an expanded focus in the FIA program, which historically was only concerned with timber resources, while more recent surveys have aimed at a more comprehensive gathering of forest biomass data. The effect of these changes in survey methods has not been estimated by USDA-FS. In general, Western National Forests show a relatively large rate of carbon sequestration concurrent with an increase in forest area. It is possible that changes in FIA sampling resulted in more forest area coming into the inventory sample in the second time period.

Appendix I. Inventory and Forecast for Black Carbon

This appendix summarizes the methods, data sources, and results of the development of an inventory and forecast for black carbon (BC) emissions in Washington. Black carbon is an aerosol (particulate matter or PM) species with positive climate forcing potential but currently without a global warming potential defined by the IPCC (see Appendix J for more information on black carbon and other aerosol species). BC is synonymous with elemental carbon (EC), which is a term common to regional haze analysis. An inventory for 2002 was developed based on inventory data from the Western Regional Air Partnership (WRAP) regional planning organization and other sources.¹¹⁴ This appendix describes these data and methods for estimating mass emissions of BC and then transforming the mass emission estimates into CO₂ equivalents (CO₂e) in order to present the emissions within a GHG context.

In addition to the PM inventory data from WRAP, PM speciation data from EPA's SPECIATE database were also used: these data include PM fractions of elemental carbon (also known as black carbon) and primary organic aerosols (also known as organic material or OM). These data come from ongoing work being conducted by E.H. Pechan & Associates, Inc. (Pechan) for EPA on updating the SPECIATE database.¹¹⁵ These new profiles have just recently been released by EPA. As will be further described below, both BC and OM emission estimates are needed to assess the CO₂e of black carbon emissions. While BC and OM emissions data are available from the WRAP regional haze inventories, CCS favored the newer speciation data available from EPA for the purposes of estimating BC and OM for most source sectors (BC and OM data from the WRAP were used only for the nonroad engines sector). In particular, better speciation data are now available from EPA for important BC emissions sources (e.g., most fossil fuel combustion sources).

After assembling the BC and OM emission estimates, the mass emission rates were transformed into their CO₂e estimates using information from recent global climate modeling. This transformation is described in later sections below.

Development of BC and OM Mass Emission Estimates

The BC and OM mass emission estimates were derived by multiplying the emissions estimates for particulate matter with an aerodynamic diameter of less than 2.5 micrometers (PM_{2.5}) by the appropriate aerosol fraction for BC and OM. The aerosol fractions were taken from Pechan's ongoing work to update EPA's SPECIATE database as approved by EPA's SPECIATE Workgroup members.

After estimating both BC and OM emissions for each source category, we used the BC estimate as described below to estimate the CO₂e emissions. Also, as described further below, the OM

¹¹⁴ Tom Moore, Western Regional Air Partnership, data files provided to Steve Roe, CCS, December 2006; Corbett, J., et al, *Estimation, Validation, and Forecasts of Regional Commercial Marine Vessel Emissions, Tasks 1 and 2: Baseline Inventory and Ports Comparison, Final Report*, May 3, 2006.

¹¹⁵ Version 4.0 of the SPECIATE database and report:
<http://www.epa.gov/ttn/chief/software/speciate/index.html#related>.

emission estimate was used to determine whether the source was likely to have positive climate forcing potential. The mass emission results for 2002 are shown in Table II.

Development of CO_{2e} for BC+OM Emissions

We used similar methods to those applied previously in Maine and Connecticut for converting BC mass emissions to CO_{2e}.¹¹⁶ These methods are based on the modeling of Jacobson (2002)¹¹⁷ and his updates to this work (Jacobson, 2005a).¹¹⁸ Jacobson (2005a) estimated a range of 90:1 to 190:1 for the climate response effects of BC+OM emissions as compared to CO₂ carbon emissions (depending on either a 30-year or 95-year atmospheric lifetime for CO₂). It is important to note that the BC+OM emissions used by Jacobson were based on a 2:1 ratio of OM:BC (his work in these papers focused on fossil fuel BC+OM; primarily diesel combustion, which has an OM:BC ratio of 2:1 or less).

For Maine and Connecticut, ENE (2004) applied climate response factors from the earlier Jacobson work (220 and 500) to the estimated BC mass to estimate the range of CO_{2e} associated with BC emissions. Note that the analysis in the northeast was limited to BC emissions from onroad diesel exhaust. An important oversight from this work is that the climate response factors developed by Jacobson (2002, 2005a) are on the basis of CO₂ carbon (not CO₂). Therefore, in order to express the BC emissions as CO_{2e}, the climate response factors should have been adjusted upward by a factor of 3.67 to account for the molecular weight of CO₂ to carbon (44/12).

For this inventory, we started with the 90 and 190 climate response factors adjusted to CO_{2e} factors of 330 and 697 to obtain a low and high estimate of CO_{2e} for each sector. An example calculation of the CO_{2e} emissions for 10 tons of PM less than 2.5 microns (PM_{2.5}) from onroad diesel exhaust follows:

$$\text{BC mass} = (10 \text{ short tons PM}_{2.5}) \times (0.613 \text{ ton EC/ton PM}_{2.5}) = 6.13 \text{ short tons BC}$$

$$\text{Low estimate CO}_{2e} = (6.13 \text{ tons BC}) (330 \text{ tons CO}_{2e}/\text{ton BC+OM}) (3 \text{ tons BC+OM/ton BC}) (0.907 \text{ metric ton/ton}) = 5,504 \text{ metric tons CO}_{2e}$$

$$\text{High estimate CO}_{2e} = (6.13 \text{ tons BC}) (697 \text{ tons CO}_{2e}/\text{ton BC+OM}) (3 \text{ tons BC+OM/ton BC}) (0.907 \text{ metric ton/ton}) = 11,626 \text{ metric tons CO}_{2e}$$

NOTE: The factor 3 tons BC+OM/ton BC comes directly from the global modeling inputs used by Jacobson (2002, 2005a; i.e., 2 tons of OM/ton of BC).

¹¹⁶ ENE, 2004. Memorandum: "Diesel Black Carbon Calculations – Reductions and Baseline" from Michael Stoddard, Environment Northeast, prepared for the Connecticut Stakeholder Dialog, Transportation Work Group, October 23, 2003.

¹¹⁷ Jacobson, 2002. Jacobson, M.Z., "Control of fossil-fuel particulate black carbon and organic matter, possibly the most effective method of slowing global warming", *Journal of Geophysical Physical Research*, volume 107, No. D19, 4410, 2002.

¹¹⁸ Jacobson, 2005a. Jacobson, M.Z., "Updates to 'Control of fossil-fuel particulate black carbon and organic matter, possibly the most effective method of slowing global warming'", *Journal of Geophysical Research Atmospheres*, February 15, 2005.

For source categories that had an OM:BC mass emissions ratio >4.0 , we zeroed out these emission estimates from the CO₂e estimates. The reason for this is that the net heating effects of OM are not currently well understood (overall OM is thought to have a negative climate forcing effect or a net cooling effect). Therefore, for source categories where the PM is dominated by OM (e.g., biomass burning), the net climate response associated with these emissions is highly uncertain and could potentially produce a net negative climate forcing potential. Further, OM/BC ratios of 4 or more are well beyond the 2:1 ratio used by Jacobson in his work.

Results and Discussion

We estimate that BC mass emissions in Washington total about 9.5 MMtCO₂e in 2002. This is the mid-point of the estimated range of emissions. The estimated range is 6.1 – 12.9 MMtCO₂e (see Table I1). The primary contributing sectors in 2002 were nonroad diesel (48%), onroad diesel (25%), nonroad gasoline (7%), commercial marine vessels (6%), and rail (6%). The commercial marine vessels (CMV) sector includes emissions for both in-port operations as well as underway emissions within 200 miles of Washington's coastline.¹¹⁹

The nonroad diesel sector includes exhaust emissions from construction/mining, industrial and agricultural engines, as well as recreational marine vessels. Agricultural engines contributed about 45% of the nonroad diesel total, while construction and mining engines contributed another 35%. For nonroad gasoline engines, primary contributors included pleasure craft (47%), lawn and garden equipment (20%), and recreational equipment (16%).

Wildfires and miscellaneous sources such as fugitive dust from paved and unpaved roads contributed a significant amount of PM and subsequent BC and OM mass emissions (see Table I1); however the OM/BC ratio is >4 for these sources, so the BC emissions were not converted to CO₂e.

CCS also performed an assessment of the primary BC contributing sectors from the 2018 WRAP forecast. A drop in the future BC emissions for the onroad and nonroad diesel sectors is expected due to new engine and fuels standards that will reduce particulate matter emissions. For the nonroad diesel sector the estimated 4.5 MMtCO₂e in 2002 drops to 1.2 MMtCO₂e in 2018. For the onroad diesel sector, 2.4 MMtCO₂e was estimated for 2002 dropping to 0.4 MMtCO₂e in 2018. No significant reductions are expected in the other emission sectors. The development of emission estimates for each of the smaller source sectors was beyond the scope of this analysis.

Data for underway commercial marine vessels were not available. However, we would expect these to be the dominant source of BC emissions in the future, since the new federal standards mentioned above are not expected to have any significant effect on this sector.

¹¹⁹ Particulate matter emissions, from the Corbett et al (2006) study referenced in the footnote above, were used as the starting point for estimating CMV emissions. These include in-port as well as underway emissions within 200 miles from shore (the Exclusive Economic Zone). The BC and OM fractions from the same speciation profiles used in the WRAP inventory (also referenced above) were applied to estimate BC and OM mass emissions, which were then transformed into their CO₂ equivalents.

While the state of science in aerosol climate forcing is still developing, there is a good body of evidence supporting the net warming impacts of black carbon. Aerosols have a *direct* radiative forcing because they scatter and absorb solar and infrared radiation in the atmosphere. Aerosols also alter the formation and precipitation efficiency of liquid water, ice and mixed-phase clouds, thereby causing an *indirect* radiative forcing associated with these changes in cloud properties (IPCC, 2001).¹²⁰ There are also a number of other indirect radiative effects that have been modeled (e.g., Jacobson, 2002).

The quantification of aerosol radiative forcing is more complex than the quantification of radiative forcing by GHGs because of the direct and indirect radiative forcing effects, and the fact that aerosol mass and particle number concentrations are highly variable in space and time. This variability is largely due to the much shorter atmospheric lifetime of aerosols compared with the important GHGs (i.e. CO₂). Spatially and temporally resolved information on the atmospheric concentration and radiative properties of aerosols is needed to estimate radiative forcing.

The quantification of indirect radiative forcing by aerosols is especially difficult. In addition to the variability in aerosol concentrations, some complicated aerosol influences on cloud processes must be accurately modeled. For example, the warm (liquid water) cloud indirect forcing may be divided into two components. The first indirect forcing is associated with the change in droplet concentration caused by increases in aerosol cloud condensation nuclei. The second indirect forcing is associated with the change in precipitation efficiency that results from a change in droplet number concentration. Quantification of the latter forcing necessitates understanding of a change in cloud liquid-water content. In addition to warm clouds, ice clouds may also be affected by aerosols.

To put the radiative forcing potential of BC in context with CO₂, the IPCC estimated the radiative forcing for a doubling of the earth's CO₂ concentration to be 3.7 watts per square meter (W/m²). For BC, various estimates of current radiative forcing have ranged from 0.16 to 0.42 W/m² (IPCC, 2001). These BC estimates are for direct radiative effects only. There is a higher level of uncertainty associated with the direct radiative forcing estimates of BC compared to those of CO₂ and other GHGs. There are even higher uncertainties associated with the assessment of the indirect radiative forcing of aerosols.

¹²⁰ IPCC, 2001. Climate Change 2001: The Scientific Basis, Intergovernmental Panel on Climate Change, 2001.

Table I1. 2002 BC Emission Estimates

Sector	Subsector	Mass Emissions			CO ₂ e		Contribution to CO ₂ e
		BC	OM	BC + OM	Low	High	
		Metric Tons			Metric Tons		
Electric Generating Units (EGUs)							
	Coal	50	72	122	49,717	105,009	0.8%
	Oil	1	1	3	1,093	2,309	0.0%
	Gas	0	27	27	0	0	0.0%
	Other	3	5	9	3,125	6,600	0.1%
Non-EGU Fuel Combustion (Residential, Commercial, and Industrial)							
	Coal	24	35	59	24,050	50,796	0.4%
	Oil	37	33	70	36,713	77,543	0.6%
	Gas	0	1,094	1,094	0	0	0.0%
	Other ^a	3,071	14,785	17,856	191,902	405,320	3.1%
Onroad Gasoline (Exhaust, Brake Wear, & Tire Wear)		226	907	1,133	78,312	165,404	1.3%
Onroad Diesel (Exhaust, Brake Wear, & Tire Wear)		1,733	729	2,462	1,543,126	3,259,268	25.3%
Aircraft		96	195	291	94,590	199,787	1.5%
Railroad ^b		371	122	492	366,903	774,944	6.0%
Commercial Marine Vessels		389	126	515	385,110	813,399	6.3%
Other Energy Use							
	Nonroad Gasoline	405	1,140	1,545	400,605	846,127	6.6%
	Nonroad Diesel	3,115	1,022	4,137	3,083,740	6,513,232	47.6%
	Other Combustion ^c	4	38	42	0	0	0.0%
Industrial Processes		67	743	810	13,334	28,164	0.2%
Agriculture ^d		349	7,486	7,834	0	0	0.0%
Waste Management							
	Landfills	0	3	3	0	0	0.0%
	Incineration	10	18	28	9,568	20,208	0.2%
	Open Burning	772	9,917	10,689	0	0	0.0%
	Other	4	6	10	4,144	8,752	0.1%
Wildfires/Prescribed Burns		830	8,124	8,954	0	0	0.0%
Miscellaneous ^e		808	13,162	13,970	0	0	0.0%
Totals		12,184	59,513	71,697	6,108,760	12,902,442	100%

^a Large stationary diesel engines and industrial wood combustion.^b Railroad includes Locomotives and Railroad Equipment Emissions.^c Other Combustion includes Motor Vehicle Fire, Structure Fire, and Aircraft/Rocket Engine Fire & Testing Emissions.^d Agriculture includes Agricultural Burning, Agriculture/Forestry and Agriculture, Food, & Kindred Spirits Emissions.^e Miscellaneous includes Paved/Unpaved Roads and Catastrophic/Accidental Release Emissions.

Appendix J. Greenhouse Gases and Global Warming Potential Values: Excerpts from the Inventory of U.S. Greenhouse Emissions and Sinks: 1990-2000

Original Reference: Material for this Appendix is taken from the *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990 - 2000*, U.S. Environmental Protection Agency, Office of Atmospheric Programs, EPA 430-R-02-003, April 2002 (www.epa.gov/globalwarming/publications/emissions). Michael Gillenwater directed the preparation of this appendix.

Introduction

The *Inventory of U.S. Greenhouse Gas Emissions and Sinks* presents estimates by the United States government of U.S. anthropogenic greenhouse gas emissions and removals for the years 1990 through 2000. The estimates are presented on both a full molecular mass basis and on a Global Warming Potential (GWP) weighted basis in order to show the relative contribution of each gas to global average radiative forcing.

The Intergovernmental Panel on Climate Change (IPCC) has recently updated the specific global warming potentials for most greenhouse gases in their Third Assessment Report (TAR, IPCC 2001). Although the GWPs have been updated, estimates of emissions presented in the U.S. *Inventory* continue to use the GWPs from the Second Assessment Report (SAR). The guidelines under which the *Inventory* is developed, the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories* (IPCC/UNEP/OECD/IEA 1997) and the United Nations Framework Convention on Climate Change (UNFCCC) reporting guidelines for national inventories¹²¹ were developed prior to the publication of the TAR. Therefore, to comply with international reporting standards under the UNFCCC, official emission estimates are reported by the United States using SAR GWP values. This excerpt of the U.S. *Inventory* addresses in detail the differences between emission estimates using these two sets of GWPs. Overall, these revisions to GWP values do not have a significant effect on U.S. emission trends.

Additional discussion on emission trends for the United States can be found in the complete *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2000*.

What is Climate Change?

Climate change refers to long-term fluctuations in temperature, precipitation, wind, and other elements of the Earth's climate system. Natural processes such as solar-irradiance variations, variations in the Earth's orbital parameters, and volcanic activity can produce variations in climate. The climate system can also be influenced by changes in the concentration of various gases in the atmosphere, which affect the Earth's absorption of radiation.

The Earth naturally absorbs and reflects incoming solar radiation and emits longer wavelength terrestrial (thermal) radiation back into space. On average, the absorbed solar radiation is balanced by the outgoing terrestrial radiation emitted to space. A portion of this terrestrial radiation, though, is itself absorbed by gases in the atmosphere. The energy from this absorbed terrestrial radiation warms the Earth's surface and atmosphere, creating what is known as the "natural greenhouse effect." Without the natural heat-trapping properties of these atmospheric gases, the average surface temperature of the Earth would be about 33°C lower (IPCC 2001).

Under the UNFCCC, the definition of climate change is "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in

¹²¹ See FCCC/CP/1999/7 at <www.unfccc.de>.

addition to natural climate variability observed over comparable time periods.” Given that definition, in its Second Assessment Report of the science of climate change, the IPCC concluded that:

Human activities are changing the atmospheric concentrations and distributions of greenhouse gases and aerosols. These changes can produce a radiative forcing by changing either the reflection or absorption of solar radiation, or the emission and absorption of terrestrial radiation (IPCC 1996).

Building on that conclusion, the more recent IPCC Third Assessment Report asserts that “[c]oncentrations of atmospheric greenhouse gases and their radiative forcing have continued to increase as a result of human activities” (IPCC 2001).

The IPCC went on to report that the global average surface temperature of the Earth has increased by between $0.6 \pm 0.2^{\circ}\text{C}$ over the 20th century (IPCC 2001). This value is about 0.15°C larger than that estimated by the Second Assessment Report, which reported for the period up to 1994, “owing to the relatively high temperatures of the additional years (1995 to 2000) and improved methods of processing the data” (IPCC 2001).

While the Second Assessment Report concluded, “the balance of evidence suggests that there is a discernible human influence on global climate,” the Third Assessment Report states the influence of human activities on climate in even starker terms. It concludes that, “[I]n light of new evidence and taking into account the remaining uncertainties, most of the observed warming over the last 50 years is likely to have been due to the increase in greenhouse gas concentrations” (IPCC 2001).

Greenhouse Gases

Although the Earth’s atmosphere consists mainly of oxygen and nitrogen, neither plays a significant role in enhancing the greenhouse effect because both are essentially transparent to terrestrial radiation. The greenhouse effect is primarily a function of the concentration of water vapor, carbon dioxide, and other trace gases in the atmosphere that absorb the terrestrial radiation leaving the surface of the Earth (IPCC 1996). Changes in the atmospheric concentrations of these greenhouse gases can alter the balance of energy transfers between the atmosphere, space, land, and the oceans. A gauge of these changes is called radiative forcing, which is a simple measure of changes in the energy available to the Earth-atmosphere system (IPCC 1996). Holding everything else constant, increases in greenhouse gas concentrations in the atmosphere will produce positive radiative forcing (i.e., a net increase in the absorption of energy by the Earth).

Climate change can be driven by changes in the atmospheric concentrations of a number of radiatively active gases and aerosols. We have clear evidence that human activities have affected concentrations, distributions and life cycles of these gases (IPCC 1996).

Naturally occurring greenhouse gases include water vapor, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and ozone (O_3). Several classes of halogenated substances that contain fluorine, chlorine, or bromine are also greenhouse gases, but they are, for the most part, solely a product of industrial activities. Chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs) are halocarbons that contain chlorine, while halocarbons that contain bromine are referred to as bromofluorocarbons (i.e., halons). Because CFCs, HCFCs, and halons are stratospheric ozone depleting substances, they are covered under the Montreal Protocol on Substances that Deplete the Ozone Layer. The UNFCCC defers to this earlier international treaty; consequently these gases are not included in national greenhouse gas inventories. Some other fluorine containing halogenated substances—hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6)—do not deplete stratospheric ozone but are potent greenhouse gases. These latter substances are addressed by the UNFCCC and accounted for in national greenhouse gas inventories.

There are also several gases that, although they do not have a commonly agreed upon direct radiative forcing effect, do influence the global radiation budget. These tropospheric gases—referred to as ambient air pollutants—include carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), and

tropospheric (ground level) ozone (O_3). Tropospheric ozone is formed by two precursor pollutants, volatile organic compounds (VOCs) and nitrogen oxides (NO_x) in the presence of ultraviolet light (sunlight). Aerosols—extremely small particles or liquid droplets—often composed of sulfur compounds, carbonaceous combustion products, crustal materials and other human induced pollutants—can affect the absorptive characteristics of the atmosphere. However, the level of scientific understanding of aerosols is still very low (IPCC 2001).

Carbon dioxide, methane, and nitrous oxide are continuously emitted to and removed from the atmosphere by natural processes on Earth. Anthropogenic activities, however, can cause additional quantities of these and other greenhouse gases to be emitted or sequestered, thereby changing their global average atmospheric concentrations. Natural activities such as respiration by plants or animals and seasonal cycles of plant growth and decay are examples of processes that only cycle carbon or nitrogen between the atmosphere and organic biomass. Such processes—except when directly or indirectly perturbed out of equilibrium by anthropogenic activities—generally do not alter average atmospheric greenhouse gas concentrations over decadal timeframes. Climatic changes resulting from anthropogenic activities, however, could have positive or negative feedback effects on these natural systems. Atmospheric concentrations of these gases, along with their rates of growth and atmospheric lifetimes, are presented in Table 10.

Table 10. Global Atmospheric Concentration (ppm Unless Otherwise Specified), Rate of Concentration Change (ppb/year) and Atmospheric Lifetime (Years) of Selected Greenhouse Gases

Atmospheric Variable	CO ₂	CH ₄	N ₂ O	SF ₆ ^a	CF ₄ ^a
Pre-industrial atmospheric concentration	278	0.700	0.270	0	40
Atmospheric concentration (1998)	365	1.745	0.314	4.2	80
Rate of concentration change ^b	1.5 ^c	0.007 ^c	0.0008	0.24	1.0
Atmospheric Lifetime	50-200 ^d	12 ^e	114 ^e	3,200	>50,000

Source: IPCC (2001)

^a Concentrations in parts per trillion (ppt) and rate of concentration change in ppt/year.

^b Rate is calculated over the period 1990 to 1999.

^c Rate has fluctuated between 0.9 and 2.8 ppm per year for CO₂ and between 0 and 0.013 ppm per year for CH₄ over the period 1990 to 1999.

^d No single lifetime can be defined for CO₂ because of the different rates of uptake by different removal processes.

^e This lifetime has been defined as an “adjustment time” that takes into account the indirect effect of the gas on its own residence time.

A brief description of each greenhouse gas, its sources, and its role in the atmosphere is given below. The following section then explains the concept of Global Warming Potentials (GWPs), which are assigned to individual gases as a measure of their relative average global radiative forcing effect.

Water Vapor (H₂O).

Overall, the most abundant and dominant greenhouse gas in the atmosphere is water vapor. Water vapor is neither long-lived nor well mixed in the atmosphere, varying spatially from 0 to 2 percent (IPCC 1996). In addition, atmospheric water can exist in several physical states including gaseous, liquid, and solid. Human activities are not believed to directly affect the average global concentration of water vapor; however, the radiative forcing produced by the increased concentrations of other greenhouse gases may indirectly affect the hydrologic cycle. A warmer atmosphere has an increased water holding capacity; yet, increased concentrations of water vapor affects the formation of clouds, which can both absorb and reflect solar and terrestrial radiation. Aircraft contrails, which consist of water vapor and other aircraft emittants, are similar to clouds in their radiative forcing effects (IPCC 1999).

Carbon Dioxide (CO₂)

In nature, carbon is cycled between various atmospheric, oceanic, land biotic, marine biotic, and mineral reservoirs. The largest fluxes occur between the atmosphere and terrestrial biota, and between the atmosphere and surface water of the oceans. In the atmosphere, carbon predominantly exists in its oxidized form as CO₂. Atmospheric carbon dioxide is part of this global carbon cycle, and therefore its fate is a complex function of geochemical and biological processes. Carbon dioxide concentrations in the atmosphere increased from approximately 280 parts per million by volume (ppmv) in pre-industrial times to 367 ppmv in 1999, a 31 percent increase (IPCC 2001). The IPCC notes that “[t]his concentration has not been exceeded during the past 420,000 years, and likely not during the past 20 million years. The rate of increase over the past century is unprecedented, at least during the past 20,000 years.” The IPCC definitively states that “the present atmospheric CO₂ increase is caused by anthropogenic emissions of CO₂” (IPCC 2001). Forest clearing, other biomass burning, and some non-energy production processes (e.g., cement production) also emit notable quantities of carbon dioxide.

In its second assessment, the IPCC also stated that “[t]he increased amount of carbon dioxide [in the atmosphere] is leading to climate change and will produce, on average, a global warming of the Earth’s surface because of its enhanced greenhouse effect—although the magnitude and significance of the effects are not fully resolved” (IPCC 1996).

Methane (CH₄)

Methane is primarily produced through anaerobic decomposition of organic matter in biological systems. Agricultural processes such as wetland rice cultivation, enteric fermentation in animals, and the decomposition of animal wastes emit CH₄, as does the decomposition of municipal solid wastes. Methane is also emitted during the production and distribution of natural gas and petroleum, and is released as a by-product of coal mining and incomplete fossil fuel combustion. Atmospheric concentrations of methane have increased by about 150 percent since pre-industrial times, although the rate of increase has been declining. The IPCC has estimated that slightly more than half of the current CH₄ flux to the atmosphere is anthropogenic, from human activities such as agriculture, fossil fuel use and waste disposal (IPCC 2001).

Methane is removed from the atmosphere by reacting with the hydroxyl radical (OH) and is ultimately converted to CO₂. Minor removal processes also include reaction with Cl in the marine boundary layer, a soil sink, and stratospheric reactions. Increasing emissions of methane reduce the concentration of OH, a feedback which may increase methane’s atmospheric lifetime (IPCC 2001).

Nitrous Oxide (N₂O)

Anthropogenic sources of N₂O emissions include agricultural soils, especially the use of synthetic and manure fertilizers; fossil fuel combustion, especially from mobile combustion; adipic (nylon) and nitric acid production; wastewater treatment and waste combustion; and biomass burning. The atmospheric concentration of nitrous oxide (N₂O) has increased by 16 percent since 1750, from a pre industrial value of about 270 ppb to 314 ppb in 1998, a concentration that has not been exceeded during the last thousand years. Nitrous oxide is primarily removed from the atmosphere by the photolytic action of sunlight in the stratosphere.

Ozone (O₃)

Ozone is present in both the upper stratosphere, where it shields the Earth from harmful levels of ultraviolet radiation, and at lower concentrations in the troposphere, where it is the main component of anthropogenic photochemical “smog.” During the last two decades, emissions of anthropogenic chlorine and bromine-containing halocarbons, such as chlorofluorocarbons (CFCs), have depleted stratospheric ozone concentrations. This loss of ozone in the stratosphere has resulted in negative radiative forcing, representing an indirect effect of anthropogenic emissions of chlorine and bromine compounds (IPCC 1996). The depletion of stratospheric ozone and its radiative forcing was expected to reach a maximum in

about 2000 before starting to recover, with detection of such recovery not expected to occur much before 2010 (IPCC 2001).

The past increase in tropospheric ozone, which is also a greenhouse gas, is estimated to provide the third largest increase in direct radiative forcing since the pre-industrial era, behind CO₂ and CH₄. Tropospheric ozone is produced from complex chemical reactions of volatile organic compounds mixing with nitrogen oxides (NO_x) in the presence of sunlight. Ozone, carbon monoxide (CO), sulfur dioxide (SO₂), nitrogen dioxide (NO₂) and particulate matter are included in the category referred to as “criteria pollutants” in the United States under the Clean Air Act and its subsequent amendments. The tropospheric concentrations of ozone and these other pollutants are short-lived and, therefore, spatially variable.

Halocarbons, Perfluorocarbons, and Sulfur Hexafluoride (SF₆).

Halocarbons are, for the most part, man-made chemicals that have both direct and indirect radiative forcing effects. Halocarbons that contain chlorine—chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), methyl chloroform, and carbon tetrachloride—and bromine—halons, methyl bromide, and hydrobromofluorocarbons (HBFCs)—result in stratospheric ozone depletion and are therefore controlled under the Montreal Protocol on Substances that Deplete the Ozone Layer. Although CFCs and HCFCs include potent global warming gases, their net radiative forcing effect on the atmosphere is reduced because they cause stratospheric ozone depletion, which is itself an important greenhouse gas in addition to shielding the Earth from harmful levels of ultraviolet radiation. Under the Montreal Protocol, the United States phased out the production and importation of halons by 1994 and of CFCs by 1996. Under the Copenhagen Amendments to the Protocol, a cap was placed on the production and importation of HCFCs by non-Article 5 countries beginning in 1996, and then followed by a complete phase-out by the year 2030. The ozone depleting gases covered under the Montreal Protocol and its Amendments are not covered by the UNFCCC.

Hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF₆) are not ozone depleting substances, and therefore are not covered under the Montreal Protocol. They are, however, powerful greenhouse gases. HFCs—primarily used as replacements for ozone depleting substances but also emitted as a by-product of the HCFC-22 manufacturing process—currently have a small aggregate radiative forcing impact; however, it is anticipated that their contribution to overall radiative forcing will increase (IPCC 2001). PFCs and SF₆ are predominantly emitted from various industrial processes including aluminum smelting, semiconductor manufacturing, electric power transmission and distribution, and magnesium casting. Currently, the radiative forcing impact of PFCs and SF₆ is also small; however, they have a significant growth rate, extremely long atmospheric lifetimes, and are strong absorbers of infrared radiation, and therefore have the potential to influence climate far into the future (IPCC 2001).

Carbon Monoxide (CO)

Carbon monoxide has an indirect radiative forcing effect by elevating concentrations of CH₄ and tropospheric ozone through chemical reactions with other atmospheric constituents (e.g., the hydroxyl radical, OH) that would otherwise assist in destroying CH₄ and tropospheric ozone. Carbon monoxide is created when carbon-containing fuels are burned incompletely. Through natural processes in the atmosphere, it is eventually oxidized to CO₂. Carbon monoxide concentrations are both short-lived in the atmosphere and spatially variable.

Nitrogen Oxides (NO_x).

The primary climate change effects of nitrogen oxides (i.e., NO and NO₂) are indirect and result from their role in promoting the formation of ozone in the troposphere and, to a lesser degree, lower stratosphere, where it has positive radiative forcing effects. Additionally, NO_x emissions from aircraft are also likely to decrease methane concentrations, thus having a negative radiative forcing effect (IPCC 1999). Nitrogen oxides are created from lightning, soil microbial activity, biomass burning – both natural and anthropogenic fires – fuel combustion, and, in the stratosphere, from the photo-degradation of nitrous

oxide (N_2O). Concentrations of NO_x are both relatively short-lived in the atmosphere and spatially variable.

Nonmethane Volatile Organic Compounds (NMVOCs)

Nonmethane volatile organic compounds include compounds such as propane, butane, and ethane. These compounds participate, along with NO_x , in the formation of tropospheric ozone and other photochemical oxidants. NMVOCs are emitted primarily from transportation and industrial processes, as well as biomass burning and non-industrial consumption of organic solvents. Concentrations of NMVOCs tend to be both short-lived in the atmosphere and spatially variable.

Aerosols

Aerosols are extremely small particles or liquid droplets found in the atmosphere. They can be produced by natural events such as dust storms and volcanic activity, or by anthropogenic processes such as fuel combustion and biomass burning. They affect radiative forcing in both direct and indirect ways: directly by scattering and absorbing solar and thermal infrared radiation; and indirectly by increasing droplet counts that modify the formation, precipitation efficiency, and radiative properties of clouds. Aerosols are removed from the atmosphere relatively rapidly by precipitation. Because aerosols generally have short atmospheric lifetimes, and have concentrations and compositions that vary regionally, spatially, and temporally, their contributions to radiative forcing are difficult to quantify (IPCC 2001).

The indirect radiative forcing from aerosols is typically divided into two effects. The first effect involves decreased droplet size and increased droplet concentration resulting from an increase in airborne aerosols. The second effect involves an increase in the water content and lifetime of clouds due to the effect of reduced droplet size on precipitation efficiency (IPCC 2001). Recent research has placed a greater focus on the second indirect radiative forcing effect of aerosols.

Various categories of aerosols exist, including naturally produced aerosols such as soil dust, sea salt, biogenic aerosols, sulphates, and volcanic aerosols, and anthropogenically manufactured aerosols such as industrial dust and carbonaceous aerosols (e.g., black carbon, organic carbon) from transportation, coal combustion, cement manufacturing, waste incineration, and biomass burning.

The net effect of aerosols is believed to produce a negative radiative forcing effect (i.e., net cooling effect on the climate), although because they are short-lived in the atmosphere—lasting days to weeks—their concentrations respond rapidly to changes in emissions. Locally, the negative radiative forcing effects of aerosols can offset the positive forcing of greenhouse gases (IPCC 1996). “However, the aerosol effects do not cancel the global-scale effects of the much longer-lived greenhouse gases, and significant climate changes can still result” (IPCC 1996).

The IPCC’s Third Assessment Report notes that “the indirect radiative effect of aerosols is now understood to also encompass effects on ice and mixed-phase clouds, but the magnitude of any such indirect effect is not known, although it is likely to be positive” (IPCC 2001). Additionally, current research suggests that another constituent of aerosols, elemental carbon, may have a positive radiative forcing (Jacobson 2001). The primary anthropogenic emission sources of elemental carbon include diesel exhaust, coal combustion, and biomass burning.

Global Warming Potentials

Global Warming Potentials (GWPs) are intended as a quantified measure of the globally averaged relative radiative forcing impacts of a particular greenhouse gas. It is defined as the cumulative radiative forcing—both direct and indirect effects—integrated over a period of time from the emission of a unit mass of gas relative to some reference gas (IPCC 1996). Carbon dioxide (CO_2) was chosen as this reference gas. Direct effects occur when the gas itself is a greenhouse gas. Indirect radiative forcing occurs when chemical transformations involving the original gas produce a gas or gases that are greenhouse gases, or when a gas influences other radiatively important processes such as the atmospheric

lifetimes of other gases. The relationship between gigagrams (Gg) of a gas and Tg CO₂ Eq. can be expressed as follows:

$$\text{Tg CO}_2 \text{ Eq} = (\text{Gg of gas}) \times (\text{GWP}) \times \left(\frac{\text{Tg}}{1,000 \text{ Gg}} \right) \text{ where,}$$

Tg CO₂ Eq. = Teragrams of Carbon Dioxide Equivalents
Gg = Gigagrams (equivalent to a thousand metric tons)

GWP = Global Warming Potential
Tg = Teragrams

GWP values allow policy makers to compare the impacts of emissions and reductions of different gases. According to the IPCC, GWPs typically have an uncertainty of roughly ± 35 percent, though some GWPs have larger uncertainty than others, especially those in which lifetimes have not yet been ascertained. In the following decision, the parties to the UNFCCC have agreed to use consistent GWPs from the IPCC Second Assessment Report (SAR), based upon a 100 year time horizon, although other time horizon values are available (see Table 11).

In addition to communicating emissions in units of mass, Parties may choose also to use global warming potentials (GWPs) to reflect their inventories and projections in carbon dioxide-equivalent terms, using information provided by the Intergovernmental Panel on Climate Change (IPCC) in its Second Assessment Report. Any use of GWPs should be based on the effects of the greenhouse gases over a 100-year time horizon. In addition, Parties may also use other time horizons. (FCCC/CP/1996/15/Add.1)

Greenhouse gases with relatively long atmospheric lifetimes (e.g., CO₂, CH₄, N₂O, HFCs, PFCs, and SF₆) tend to be evenly distributed throughout the atmosphere, and consequently global average concentrations can be determined. The short-lived gases such as water vapor, carbon monoxide, tropospheric ozone, other ambient air pollutants (e.g., NO_x, and NMVOCs), and tropospheric aerosols (e.g., SO₂ products and black carbon), however, vary spatially, and consequently it is difficult to quantify their global radiative forcing impacts. GWP values are generally not attributed to these gases that are short-lived and spatially inhomogeneous in the atmosphere.

Table 11. Global Warming Potentials (GWP) and Atmospheric Lifetimes (Years) Used in the Inventory

Gas	Atmospheric Lifetime	100-year GWP ^a	20-year GWP	500-year GWP
Carbon dioxide (CO ₂)	50-200	1	1	1
Methane (CH ₄) ^b	12 \pm 3	21	56	6.5
Nitrous oxide (N ₂ O)	120	310	280	170
HFC-23	264	11,700	9,100	9,800
HFC-125	32.6	2,800	4,600	920
HFC-134a	14.6	1,300	3,400	420
HFC-143a	48.3	3,800	5,000	1,400
HFC-152a	1.5	140	460	42
HFC-227ea	36.5	2,900	4,300	950
HFC-236fa	209	6,300	5,100	4,700
HFC-4310mee	17.1	1,300	3,000	400
CF ₄	50,000	6,500	4,400	10,000
C ₂ F ₆	10,000	9,200	6,200	14,000
C ₄ F ₁₀	2,600	7,000	4,800	10,100
C ₆ F ₁₄	3,200	7,400	5,000	10,700
SF ₆	3,200	23,900	16,300	34,900

Source: IPCC (1996)

^a GWPs used here are calculated over 100 year time horizon

^b The methane GWP includes the direct effects and those indirect effects due to the production of tropospheric ozone and stratospheric water vapor. The indirect effect due to the production of CO₂ is not included.

Table 12 presents direct and net (i.e., direct and indirect) GWPs for ozone-depleting substances (ODSs). Ozone-depleting substances directly absorb infrared radiation and contribute to positive radiative forcing; however, their effect as ozone-depleters also leads to a negative radiative forcing because ozone itself is a potent greenhouse gas. There is considerable uncertainty regarding this indirect effect; therefore, a range of net GWPs is provided for ozone depleting substances.

Table 12. Net 100-year Global Warming Potentials for Select Ozone Depleting Substances*

Gas	Direct	Net _{min}	Net _{max}
CFC-11	4,600	(600)	3,600
CFC-12	10,600	7,300	9,900
CFC-113	6,000	2,200	5,200
HCFC-22	1,700	1,400	1,700
HCFC-123	120	20	100
HCFC-124	620	480	590
HCFC-141b	700	(5)	570
HCFC-142b	2,400	1,900	2,300
CHCl ₃	140	(560)	0
CCl ₄	1,800	(3,900)	660
CH ₃ Br	5	(2,600)	(500)
Halon-1211	1,300	(24,000)	(3,600)
Halon-1301	6,900	(76,000)	(9,300)

Source: IPCC (2001)

* Because these compounds have been shown to deplete stratospheric ozone, they are typically referred to as ozone depleting substances (ODSs). However, they are also potent greenhouse gases. Recognizing the harmful effects of these compounds on the ozone layer, in 1987 many governments signed the *Montreal Protocol on Substances that Deplete the Ozone Layer* to limit the production and importation of a number of CFCs and other halogenated compounds. The United States furthered its commitment to phase-out ODSs by signing and ratifying the Copenhagen Amendments to the *Montreal Protocol* in 1992. Under these amendments, the United States committed to ending the production and importation of halons by 1994, and CFCs by 1996. The IPCC Guidelines and the UNFCCC do not include reporting instructions for estimating emissions of ODSs because their use is being phased-out under the *Montreal Protocol*. The effects of these compounds on radiative forcing are not addressed here.

The IPCC recently published its Third Assessment Report (TAR), providing the most current and comprehensive scientific assessment of climate change (IPCC 2001). Within that report, the GWPs of several gases were revised relative to the IPCC's Second Assessment Report (SAR) (IPCC 1996), and new GWPs have been calculated for an expanded set of gases. Since the SAR, the IPCC has applied an improved calculation of CO₂ radiative forcing and an improved CO₂ response function (presented in WMO 1999). The GWPs are drawn from WMO (1999) and the SAR, with updates for those cases where new laboratory or radiative transfer results have been published. Additionally, the atmospheric lifetimes of some gases have been recalculated. Because the revised radiative forcing of CO₂ is about 12 percent lower than that in the SAR, the GWPs of the other gases relative to CO₂ tend to be larger, taking into account revisions in lifetimes. However, there were some instances in which other variables, such as the radiative efficiency or the chemical lifetime, were altered that resulted in further increases or decreases in particular GWP values. In addition, the values for radiative forcing and lifetimes have been calculated for a variety of halocarbons, which were not presented in the SAR. The changes are described in the TAR as follows:

New categories of gases include fluorinated organic molecules, many of which are ethers that are proposed as halocarbon substitutes. Some of the GWPs have larger uncertainties than that of others, particularly for those gases where detailed laboratory data on lifetimes are not yet available. The direct GWPs have been calculated relative to CO₂ using an improved calculation of the CO₂ radiative forcing, the SAR response function for a CO₂ pulse, and new values for the radiative forcing and lifetimes for a number of halocarbons.

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