



Technical Memorandum

Date December 17, 2021

Project: Chehalis River Basin Flood Damage Reduction Project

To: Chehalis Basin Flood Control Zone District

From: HDR

Subject: Additional Information – Environmental Justice Benefits of the Proposed FRE Project

1.0 Introduction

The purpose of this Technical Memorandum (TM) is to evaluate the benefits of the Chehalis Flood Damage Reduction Project (proposed project) to environmental justice communities in the study area. The primary purpose of the proposed project is to reduce flood impacts and one of the main beneficiaries of the project would be environmental justice communities. As such, this analysis focuses specifically on the benefits that the proposed project would have through the reduction of flooding on community facilities and residential communities in the study area. Community facilities are physical facilities provided for the benefit of community members. Continued flooding of these facilities has a significant detrimental effect on community cohesion and quality of life for those served.

The proposed project includes two flood reduction components: (1) a flood reduction facility (FRE facility) that would retain flood flows during major or greater flood events and (2) modifications to the existing levee at the Chehalis-Centralia Airport (Airport). The purpose of the proposed project is to provide flood protection during major or greater flood events to reduce the risk of flooding to life and property in the Chehalis River Basin.

The Draft Environmental Impact Statements (EISs) prepared by the Washington Department of Ecology (pursuant to the State Environmental Policy Act [SEPA]) and the U.S. Army Corps of Engineers (USACE) (pursuant to the National Environmental Policy Act [NEPA]) evaluate anticipated impacts on resources associated with construction and operation of the proposed project. In addition to resources of the natural and built environments, the draft SEPA and NEPA EISs evaluated the potential impacts on environmental justice communities in the Chehalis River Basin.

The draft SEPA and NEPA EISs focused on the potential *adverse* effects of implementing the proposed project on environmental justice communities by describing impacts on other resources (e.g., air quality, land use, environmental health and safety, fish species and habitats) and the potential for those impacts to affect environmental justice communities. However, neither Draft EIS quantified the direct impacts of future flooding without implementation of the FRE and levee enhancement projects on environmental justice communities. The SEPA EIS specifically did not consider or describe the potential benefits to environmental justice

communities from the reduction in flooding to structures and facilities that serve those communities. These benefits are the primary purpose of developing and operating the proposed project.

To identify and quantify the impacts on environmental justice communities that will occur if the proposed project is not developed and operated, the Chehalis Basin Flood Control Zone District (District) has supported the analysis contained in this TM prepared by HDR Engineering, Inc., the District's consultant. The District is providing this additional information for consideration by Ecology and the USACE to inform their preparation of Final EISs under SEPA and NEPA. Within the context of the EISs, the section that assesses the effects of not developing and operating the proposed project would be found in the alternatives analysis under the no action alternative. To the extent that these effects are negative, avoiding them by construction and operation of the proposed project could be termed a benefit of the project. In this TM, the term benefits is meant to convey the avoidance of significant negative effects to environmental justice communities.

The additional information presented in this TM provides a more detailed consideration of the potential *beneficial* effects of the proposed project by including modeled hydrology information for the Chehalis River Basin, specifically the projected increase in flooding due to climate change. It also includes a comparison of flooding impacts on environmental justice communities and the facilities that service those communities under the future conditions with and without the proposed project. The results indicate that the proposed project, when compared to a future without the project, provides flood protection to environmental justice community facilities through a reduction in the magnitude and extent of flooding in those communities and throughout Chehalis River Basin.

2.0 Environmental Justice Overview

Environmental justice is defined by the U.S. Environmental Protection Agency (USEPA) as the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies (USEPA 1998). The NEPA and SEPA EIS analyses utilized slightly different methodologies to identify environmental justice communities and potential impacts on those communities within the project study area. Both EISs classified environmental justice communities as including minority, low-income, or Native American Tribal groups. However, each EIS used a different approach to make the determination as to whether the presence of a minority, low-income, or Native American Tribal group would be classified as an environmental justice community.

2.1 Environmental Justice Communities

The NEPA and SEPA EISs both evaluated U.S. Census Bureau block groups that intersect the EIS study area for the presence of environmental justice communities. Within the block groups, the percentage of minority or low-income populations within a given block group was evaluated and compared to the overall population of the study area.

2.1.1 NEPAEIS

Under the NEPA EIS, a block group is considered to contain a “minority population” that would be considered an environmental justice community if 50 percent of the total population identifies as an ethnic or racial minority, or if the percentage of the minority population is more than 10 percent higher than the minority population of the county in which it is located. Five census blocks groups were identified with minority populations that would be considered environmental justice populations.

A block group is considered to contain a “low-income population” that would be considered an environmental justice community if 20 percent or more of the block group population has an income level below the U.S. Census Bureau’s poverty threshold or if the proportion of the population with an income level below the poverty threshold exceeds the county proportion. Fifteen census block groups were identified with low-income populations that would be considered environmental justice populations.

The NEPA analysis assumed that the Chehalis River and other waters in the study area are used by tribes. The Chehalis Reservation is located within the study area, and the Quinault Indian Nation’s usual and accustomed fishing grounds include the entire Chehalis Basin. Native American Tribes that traditionally hunted, fished, and gathered the resources in the study area represent an environmental justice population.

2.1.2 SEPAEIS

Under the SEPA EIS, a block group is considered to have a “minority population” if the total minority percentage within the block group is 10 percent greater than the minority percentage of Lewis County. Twenty-five census block groups were identified with minority populations that would be considered environmental justice populations.

A block group is considered a “low-income population” if the percentage of people living at or below twice the poverty level is greater than the percentage for Lewis County. Twenty-five census block groups were identified with low-income populations that would be considered environmental justice populations.

The SEPA analysis notes that the Chehalis Tribe reservation is located along the mainstem Chehalis River south of US Highway 12, within the study area. Members of the Chehalis Tribe, Cowlitz Indian Tribe, Quinault Indian Nation, and Shoalwater Bay Indian Tribe of the Shoalwater Bay Indian Reservation may live throughout the study area. Census data are available for recognized reservations (and in some cases, tribal trust land), but data are not available relative to tribal membership. Tribal members who may not reside on reservations could still be affected by the proposed project. To the extent that there is a potential for disproportionate impacts on a tribal community, tribal representation would be sought in a manner that is consistent with the government-to-government relationship between the United States and tribal governments and Washington State and tribal governments.

2.2 Environmental Justice Impacts

The NEPA and SEPA environmental justice analyses qualitatively evaluated whether the alternatives would disproportionately affect environmental justice populations compared to the

general population of the study area. Further, both analyses provided qualitative assessments of impacts on environmental justice communities suggesting that impacts would be derived from impacts on other resource areas (e.g., air quality, land use, environmental health and safety, aquatic species and habitats). It is important to note that neither analysis compared the extent of flood damage that would occur to environmental justice communities for the no action alternative and the proposed action alternative (proposed project), and neither analysis considered potential impacts on environmental justice communities from future climate change.

2.2.1 NEPAEIS

Under the no action alternative, the NEPA analysis concluded that there would be medium to high impact from continued declines in aquatic and terrestrial species important to environmental justice populations, including tribes, and high impacts from continued risk of major or greater flooding. Under the proposed action, the NEPA analysis concluded that there would be high direct and indirect impacts during construction from a reduced ability to derive culturally and spiritually meaningful enjoyment in the study area and low direct impact from increased air and noise emissions. Additionally, during operations, there would be a high indirect disproportionate impact from natural resource impacts and a beneficial impact from reducing risk of major or greater flooding.

2.2.2 SEPAEIS

Under the no action alternative, the SEPA analysis concluded that environmental justice populations would continue to experience substantial and disproportionate flood risk from a major or catastrophic flood. Under the proposed action, the SEPA analysis concluded that there would be no disproportionate adverse impacts from construction activities. The SEPA analysis concluded that, during operations, there would be significant and disproportionate adverse impacts relative to an environmental justice evaluation of the environmental health and safety impacts from operations during a catastrophic event, causing the FRE facility to breach or fail while the temporary reservoir is holding water.

3.0 Methodology

The analysis conducted for this TM utilized GIS mapping to evaluate the potential beneficial effects of the proposed project through a comparison of the potential for flooding to impact environmental justice communities and the facilities that serve those communities under the no action alternative and proposed project alternative. Hydrologic modeling data was used to identify the extent and magnitude (Water Surface Elevation [WSEL]) of flooding under two scenarios (proposed project and no action) with the consideration of climate change. Environmental justice communities and their relative locations within the Chehalis River Basin were identified using the same criteria as the draft NEPA and SEPA EIS analyses. Subsequently, community facilities were identified and mapped (see Section 3.3) relative to the hydrologic modeling scenarios to compare the extent of flood damage expected from the no action alternative and proposed project alternative. The results of the mapping exercise are provided in Attachment A and further described in Section 4.0.

3.1 Hydrologic Modeling

The Chehalis River Basin hydrologic model (WSE 2019a) and RiverFlow2D model (WSE 2019b) were developed by Watershed Sciences and Engineering (WSE) to inform the development of the projects design and were used by Ecology in the Draft SEPA analysis to estimate the impacts of climate change and the proposed project on the hydrology of the Chehalis River Basin. WSE considered the proposed FRE facility, and an estimated 4-foot height raise to the existing Airport Levee. The 2019 Anchor QEA memorandum documents the preparation of streamflow and flooding estimates under future climate change conditions (Anchor QEA 2019a):

“The streamflow estimates use the information contained in the Chehalis River Basin Hydrologic Modeling (WSE 2019a) technical memorandum combined with U.S. Geological Survey (USGS) flow records to develop flows under future climate change conditions. The flows were input to the 2D model developed for the Chehalis River Basin Existing Conditions RiverFlow2D Model Development and Calibration (WSE 2019b) technical memorandum to estimate flooding conditions under future climate change conditions.”

For the analysis of environmental justice populations and community facilities, two scenarios were used for the mapping exercise of community facilities:

- Late century, catastrophic flood with the proposed project alternative
- Late century, catastrophic flood with the no action alternative

Catastrophic flood refers to a 100-year flood event as measured at Grand Mound gage. The 100-year flood flow (flood with a 1 percent chance of occurrences in any given year) is projected to increase under climate change conditions by 26–50 percent by 2080. This projection would mean that the peak 100-year flood flow at the Grand Mound gage would increase from the present value of 75,000 cubic feet second (cfs) to between 94,500 and 112,250 cfs.

3.2 Environmental Justice Populations

Environmental justice populations evaluated in this analysis were selected by utilizing the environmental justice populations that were identified in the NEPA and SEPA EISs. As previously described, the environmental justice populations identified in the NEPA and SEPA EISs differed; therefore, this analysis conservatively includes any U.S. Census block group that was identified in either the NEPA EIS or SEPA EIS as an environmental justice population.

3.3 Community Facilities

Community facilities are physical facilities provided in the community for the benefit of community members. For the purposes of this analysis, community facilities are defined as facilities that serve environmental justice communities within the study area. The following types of facilities were identified:

- Educational facilities including schools and daycares
- Parks
- Museums and libraries

- Places of worship
- Hospitals and nursing homes
- Police stations
- Fire stations

These facilities are important to environmental justice communities as they are often the central gathering places around which a community is defined and are often associated with improved quality of life for those they serve. Educational facilities provide learning opportunities. Parks provide green space and places for community recreation. Museums and libraries facilitate sharing of knowledge and ideas. Places of worship serve the spiritual needs of a community. Medical facilities, police stations, and fire stations safeguard the health of the community.

3.4 Residential Communities

In this analysis, residential communities are defined to include areas where environmental justice populations reside. This is an important consideration, as the impacts from flooding would be expected to be felt most acutely in people’s residences. It is not feasible to identify specific residences or parcels that are occupied by an environmental justice population; therefore, this analysis evaluates the geographic extent of flooding expected within each census tract defined to include an environmental justice population under the proposed project and no action alternative. This represents a conservative estimate of the potential impacts on residential structures since not all areas impacted by flooding in the census tracts would be residential in nature.

4.0 Results

4.1 Environmental Justice Communities

There are 48 block groups within the study area that were considered to have environmental justice populations based on the environmental justice populations identified in the NEPA and SEPA EISs. Those that were designated as environmental justice populations according to the criteria used in the SEPA and NEPA analyses are shown in Table 1. The location of these populations are shown on Figure 1.

Table 1. Environmental Justice Populations in the Study Area

Census Tract	Block Group	Environmental Justice Population	Census Tract	Block Group	Environmental Justice Population
400	BG 1	Yes	7	BG 1	Yes
400	BG 2	No	7	BG 3	No
400	BG 4	Yes	9701	BG 1	No
500	BG 1	Yes	9701	BG 2	Yes
500	BG 3	Yes	9702	BG 1	Yes
500	BG 4	No	9702	BG 2	No
700	BG 1	Yes	9703	BG 2	Yes

Census Tract	Block Group	Environmental Justice Population	Census Tract	Block Group	Environmental Justice Population
700	BG 2	No	9703	BG 3	Yes
700	BG 3	No	9705	BG 1	No
800	BG 2	No	9705	BG 2	Yes
800	BG 3	No	9706	BG 1	Yes
12720	BG 1	Yes	9706	BG 2	Yes
12720	BG 5	Yes	9707	BG 1	No
12730	BG 1	Yes	9707	BG 2	Yes
970100	BG 1	No	9707	BG 3	No
970100	BG 2	No	9707	BG 4	Yes
970200	BG 1	No	9708	BG 1	Yes
970200	BG 2	Yes	9708	BG 2	No
970300	BG 1	Yes	9708	BG 4	Yes
970300	BG 2	Yes	9709	BG 1	Yes
970300	BG 3	No	9709	BG 2	Yes
970300	BG 4	Yes	9710	BG 1	Yes
970400	BG 1	Yes	9714	BG 1	No
970400	BG 2	Yes	9715	BG 3	No
970400	BG 3	Yes	9715	BG 4	No
970500	BG 1	Yes	9715	BG 5	No
970500	BG 2	Yes	127.2	BG 1	No
970600	BG 1	Yes	127.2	BG 5	No
970600	BG 2	Yes	127.3	BG 1	Yes
970700	BG 1	Yes	971000	BG 1	Yes
970700	BG 2	Yes	971000	BG 2	Yes
970700	BG 3	Yes	971100	BG 1	No
970700	BG 4	Yes	971400	BG 1	No
970800	BG 1	Yes	971500	BG 3	No
970800	BG 2	Yes	971500	BG 4	No
970800	BG 3	Yes	971500	BG 5	No
970800	BG 4	Yes	950400	BG 1	No
970900	BG 1	Yes	950400	BG 2	Yes
970900	BG 2	Yes			

4.2 Community Facilities

Under the no action alternative, 39 of the 118 community facilities (or about 33 percent) identified in the study area would be expected to experience flooding (Table 2; Attachment A, Figures 2 to 11). With the implementation of the proposed project, the number of community facilities experiencing flooding would be reduced to 25, or about 21 percent of the community facilities in the study area (Table 2; Attachment A, Figures 12 to 20). The 14 facilities that would have reduced potential to experience flooding would include 3 daycares, 1 fire station, 3 parks, 5 places of worship, 1 school, and 1 police station. It is likely that all of the community facilities throughout the study area serve environmental justice populations in some way. However, if the community facilities are conservatively restricted geographically to only those that are found within the geographic area of the block groups that contain environmental justice communities, the number of community facilities where flooding would be eliminated by the proposed project would be eight.

Table 2. Change in Community Facility Flooding under Proposed Action

Community Facility	Facility Type	Located within a Geographic Area with Environmental Justice Populations	No Action		Proposed Action	
			Flooding (yes/no)	Flood Elevation (feet)	Flooding (yes/no)	Flood Elevation (feet)
Mother Hubbards Day Care	Daycare	Yes	No	0	No	0
Valued Kids Childcare Center ^a	Daycare	Yes	Yes	182	No	0
Mother Hubbard Daycare Gold Street	Daycare	No	No	0	No	0
Little Inspirations Child Care ^a	Daycare	Yes	Yes	181	No	0
Centralia College Children's	Daycare	Yes	No	0	No	0
Gather & Grow Childcare Center	Daycare	Yes	Yes	182	Yes	182
Centralia Center West Lewis County Head Start ^a	Daycare	No	Yes	177	No	0
Cooks Hill Community Childcare	Daycare	Yes	No	0	No	0
Centralia Cubs Day Care	Daycare	No	No	0	No	0
Happy Day Child Care Center	Daycare	No	No	0	No	0
Popes Kids Place	Daycare	Yes	No	0	No	0
Chehalis Indian Child Care Center	Daycare	Yes	No	0	No	0
Ymca of Grays Harbor Oakville	Daycare	Yes	No	0	No	0
Lewis County Fire District 13 Station 2	Fire stations	No	Yes	234	Yes	232

Community Facility	Facility Type	Located within a Geographic Area with Environmental Justice Populations	No Action		Proposed Action	
			Flooding (yes/no)	Flood Elevation (feet)	Flooding (yes/no)	Flood Elevation (feet)
Thurston County Fire District 16 Gibson Valley Fire Department	Fire station	Yes	Yes	224	Yes	224
Lewis County Fire District 5 Station 2	Fire station	No	No	0	No	0
Grays Harbor Fire District 5 Station 52 Porter	Fire station	No	No	0	No	0
Lewis County Fire District 13 Station 1	Fire station	No	No	0	No	0
Chehalis Fire Department	Fire station	Yes	No	0	No	0
Lewis County Fire District 6 Station 62	Fire station	No	No	0	No	0
Centralia Fire Department	Fire station	No	Yes	185	Yes	184
Lewis County Fire District 12 Riverside Fire Authority Station 2	Fire station	Yes	No	0	No	0
Grays Harbor Fire District 1 Station 1	Fire station	Yes	No	0	No	0
Lewis County Fire District 16 Station 2^a	Fire station	No	Yes	267	No	0
Providence Chehalis Physical Therapy	Hospital	Yes	Yes	187	Yes	186
Providence Centralia Hospital	Hospital	Yes	No	0	No	0
Oakville Timberland Library	Library	Yes	No	0	No	0
Centralia Timberland Library	Library	Yes	No	0	No	0
Kirk Library	Library	Yes	No	0	No	0
Chehalis-Centralia Railroad & Museum	Museum	Yes	Yes	187	Yes	186
Veterans Memorial Museum	Museum	Yes	Yes	187	Yes	186
King Agriculture Museum	Museum	Yes	Yes	189	Yes	188
Busek Auto Museum	Museum	No	No	0	No	0
Claquato Church	Museum	No	No	0	No	0
Sharon Care Center	Nursing home	Yes	No	0	No	0
Cooks Hill Manor	Nursing home	Yes	No	0	No	0
Stillwaters Colonial Residence	Nursing home	Yes	No	0	No	0

Community Facility	Facility Type	Located within a Geographic Area with Environmental Justice Populations	No Action		Proposed Action	
			Flooding (yes/no)	Flood Elevation (feet)	Flooding (yes/no)	Flood Elevation (feet)
Prestige Post-Acute and Rehab Center - Centralia	Nursing home	Yes	No	0	No	0
Riverside Nursing and Rehabilitation Center	Nursing home	Yes	Yes	179	Yes	177
Chehalis West Retirement Center Inc.	Nursing home	Yes	No	0	No	0
Housing Resource Center	Nursing home	No	Yes	182	Yes	180
Fort Borst Park	Park	No	Yes	177	Yes	175
Rainbow Falls State Park ^a	Park	No	Yes	292	No	0
Willapa Hills Trail ^a	Park	No	Yes	201	No	0
Alexander Park	Park	No	Yes	187	Yes	186
Stan Hedwall Park	Park	No	Yes	188	Yes	187
Penny Playground	Park	Yes	No	0	No	0
Westside Park	Park	Yes	No	0	No	0
Southwest Washington Fairgrounds	Park	Yes	Yes	182	Yes	179
Riverside Park	Park	Yes	Yes	180	Yes	180
Pearl Street Pool	Park	No	No	0	No	0
Wagner Park ^a	Park	Yes	Yes	179	No	0
Cedar Street Park	Park	Yes	Yes	180	Yes	178
Seminary Hill Natural Area	Park	Yes	No	0	No	0
George Washington Park	Park	No	No	0	No	0
Centralia Bible Chapel	Place of worship	Yes	No	0	No	0
Grace International Churches and Ministries Inc	Place of worship	Yes	No	0	No	0
Church of The Nazarene	Place of worship	Yes	No	0	No	0
Gather Church	Place of worship	Yes	Yes	182	Yes	182
Lite of Life Ministries	Place of worship	Yes	Yes	181	Yes	181
St. Mary	Place of worship	Yes	No	0	No	0
Centralia Community Church of God ^a	Place of worship	Yes	Yes	172	No	0
Alder Street Baptist Church	Place of worship	No	Yes	181	Yes	178

Community Facility	Facility Type	Located within a Geographic Area with Environmental Justice Populations	No Action		Proposed Action	
			Flooding (yes/no)	Flood Elevation (feet)	Flooding (yes/no)	Flood Elevation (feet)
Central Bible Evangelical Free Church	Place of worship	Yes	No	0	No	0
Dryad Community Baptist Church	Place of worship	Yes	No	0	No	0
Calvary Assembly of God	Place of worship	No	No	0	No	0
Grace Foursquare Church	Place of worship	Yes	No	0	No	0
Adna Evangelical Church	Place of worship	No	Yes	200	Yes	198
Independent Assemblies of God	Place of worship	No	No	0	No	0
Church of God of Prophecy ^a	Place of worship	Yes	Yes	181	No	0
Lewis County Adventist School	Place of worship	Yes	No	0	No	0
Bethel Church of the Assemblies of God	Place of worship	No	Yes	241	Yes	241
Larry Radach Evangelistic Association ^a	Place of worship	No	Yes	181	No	0
Napavine Community Church	Place of worship	Yes	No	0	No	0
Cooks Hill Community Church ^a	Place of worship	Yes	Yes	174	No	0
Cornerstone Christian Center Ministries ^a	Place of worship	Yes	Yes	181	No	0
Chehalis Gospel Assembly	Place of worship	Yes	No	0	No	0
Praise and Worship Center	Place of worship	Yes	No	0	No	0
Dayspring Baptist Church of Chehalis Washington	Place of worship	Yes	No	0	No	0
Water of Life	Place of worship	Yes	Yes	85	Yes	83
Immanuel Lutheran Church	Place of worship	Yes	No	0	No	0
Bethel Church	Place of worship	No	Yes	185	Yes	184
Full Gospel Family Worship Center Inc.	Place of worship	No	No	0	No	0
Chehalis Foursquare Church	Place of worship	Yes	No	0	No	0
International Church of the Foursquare Gospel	Place of worship	Yes	No	0	No	0

Community Facility	Facility Type	Located within a Geographic Area with Environmental Justice Populations	No Action		Proposed Action	
			Flooding (yes/no)	Flood Elevation (feet)	Flooding (yes/no)	Flood Elevation (feet)
United Methodist Church of Oakville	Place of worship	Yes	Yes	85	Yes	84
First Presbyterian Church of Centralia	Place of worship	Yes	No	0	No	0
Church of Jesus Christ of Latter-Day Saints	Place of worship	Yes	No	0	No	0
Twin Cities Church of Christ	Place of worship	No	No	0	No	0
Centralia Seventh-Day Adventist Church	Place of worship	No	No	0	No	0
Lewis County Sheriff's office	Police station	No	No	0	No	0
Centralia Police Department	Police station	Yes	No	0	No	0
Washington State Patrol - Chehalis ^a	Police station	No	Yes	183	No	0
Chehalis Tribe Law Enforcement	Police station	Yes	No	0	No	0
Centralia College	School	Yes	No	0	No	0
Centralia High School	School	Yes	No	0	No	0
Edison Elementary	School	No	No	0	No	0
Centralia Middle School	School	Yes	No	0	No	0
Washington Elementary School	School	No	Yes	182	Yes	180
Green Hill Academic School	School	No	No	0	No	0
Adna Middle/High School ^a	School	Yes	Yes	199	No	0
Lewis County Juvenile Detention	School	No	No	0	No	0
Lewis County Alternative School	School	Yes	No	0	No	0
Lewis County Jail	School	Yes	No	0	No	0
Pe Ell School	School	No	No	0	No	0
Jefferson Lincoln Elementary	School	No	No	0	No	0
Oakville Elementary	School	Yes	No	0	No	0
Rochester Primary School	School	Yes	No	0	No	0
Oakville High School	School	Yes	No	0	No	0
Early Learning Center	School	Yes	No	0	No	0
Futurus High School	School	No	No	0	No	0

Community Facility	Facility Type	Located within a Geographic Area with Environmental Justice Populations	No Action		Proposed Action	
			Flooding (yes/no)	Flood Elevation (feet)	Flooding (yes/no)	Flood Elevation (feet)
Adna Elementary School	School	No	No	0	No	0
Grand Mound Elementary	School	No	No	0	No	0
Fords Prairie Elementary	School	Yes	No	0	No	0
Boistfort School	School	Yes	No	0	No	0
Trojan Alternative School	School	No	No	0	No	0
Lewis County Adventist School	School	No	No	0	No	0
Centralia Christian School	School	No	Yes	182	Yes	179

^a Facility would be flooded under the no action alternative but protected under the proposed project.

4.3 Residential Communities

Under the no action alternative, 27,981 acres of the census tracts identified as containing an environmental justice population would be expected to experience flooding (Table 3; Attachment A, Figures 21 to 28). With the implementation of the proposed project, the number of acres expected to experience flooding would be reduced to 26,194 (Table 3, Attachment A, Figures 29 to 36). This would represent a 1,787-acre reduction in likely residential areas occupied by environmental justice populations that would be expected to experience flooding. Although the entirety of these areas is not strictly residential in nature and contains a mix of population types, this would still be representative of an approximate reduction in flooding on residential structures associated with environmental justice populations within the study area since much of the residential development in these census tracts is concentrated in flood-prone areas along the river.

Within these census tracts, there is also a beneficial impact on environmental justice residential populations from a reduction in the severity of flooding, as measured by flood elevation. As noted in Table 3, the average change in flood elevation would be reduced by up to 3.08 feet. A reduction in the flood elevation may also represent a reduction in the duration of flooding in specific areas, resulting in a potential reduction in the damages to specific properties. In areas where flooding would not be eliminated, reducing the severity of flooding would be a long-term beneficial impact on residential environmental justice populations.

Table 3. Residential Community Flooding

Environmental Justice Census Tract Experiencing Flooding	Block Group	Area of No Action Flooding (acres)	Proposed Action Flooding (acres)	Average Change in Flood Elevation (feet)
7	BG 1	7,130.13	6,899.84	-1.22
127.3	BG 1	1,796.93	1,604.23	-1.12
700	BG 1	7,130.13	6,899.84	-1.22

Environmental Justice Census Tract Experiencing Flooding	Block Group	Area of No Action Flooding (acres)	Proposed Action Flooding (acres)	Average Change in Flood Elevation (feet)
12720	BG 1	1,781.04	1,582.67	-0.70
12720	BG 5	3,157.24	2,935.20	-1.42
12730	BG 1	1,796.93	1,604.22	-1.12
970200	BG 2	57.22	49.77	-0.42
970300	BG 1	62.26	61.23	0.0
970300	BG 2	883.97	825.52	-0.62
970300	BG 4	24.20	23.78	0.0
970400	BG 1	33.21	33.21	0.0
970400	BG 3	26.65	26.65	0.0
970500	BG 2	93.89	93.32	-0.01
970600	BG 1	86.77	75.19	-0.38
970600	BG 2	135.70	96.05	-1.64
970700	BG 2	34.25	17.38	-2.96
970700	BG 3	72.11	40.34	-1.38
970700	BG 4	557.28	436.41	-2.94
970800	BG 1	516.71	456.33	-3.08
970800	BG 2	1,174.78	1,053.26	-2.71
970800	BG 4	25.98	18.75	-0.99
970900	BG 1	332.87	315.50	-0.93
970900	BG 2	11.87	8.70	-0.91
971000	BG 1	1,059.22	1,037.53	-0.56
Total		27,981.34	26,194.92	--

5.0 Conclusions

There are 39 community facilities and 27,981 acres of environmental justice residential communities that would continue to be impacted by flooding under the no action alternative throughout the study area. With the implementation of the proposed project, the potential for flooding would be reduced in 14 of these facilities, and the acreage of flooding in residential communities would be reduced by 1,787 acres. These results indicate that the proposed project in comparison to the no action alternative serves to protect important community facilities and residential communities associated with environmental justice communities by either reducing or eliminating the threat of flooding to those facilities.

6.0 References

- Anchor QEA (Anchor QEA, LLC). 2019a. Memorandum to: Andrea McNamara Doyle and Chrissy Bailey, Office of Chehalis Basin. Regarding: Chehalis River Basin Climate Change Flows and Flooding Results. May 6, 2019.
- Anchor QEA. 2019b. Chehalis-Centralia Airport Levee Wetland Delineation Report. Chehalis River Basin Flood Damage Reduction Proposed Project. Prepared for Washington Department of Ecology and U.S. Army Corps of Engineers. Prepared by Anchor QEA, LLC. May 2019.
- USEPA (U.S. Environmental Protection Agency). 1998. Environmental Justice. Available at: <https://www.epa.gov/environmentaljustice>
- WSE (Watershed Sciences and Engineering). 2019a. Memorandum to: Bob Montgomery, Anchor QEA, LLC. Regarding: Chehalis River Basin Hydrologic Modeling. February 28, 2019.
- WSE. 2019b. Memorandum to: Bob Montgomery, Anchor QEA, LLC. Regarding: Chehalis River Existing Conditions RiverFlow2D Model Development and Calibration. February 28, 2019.

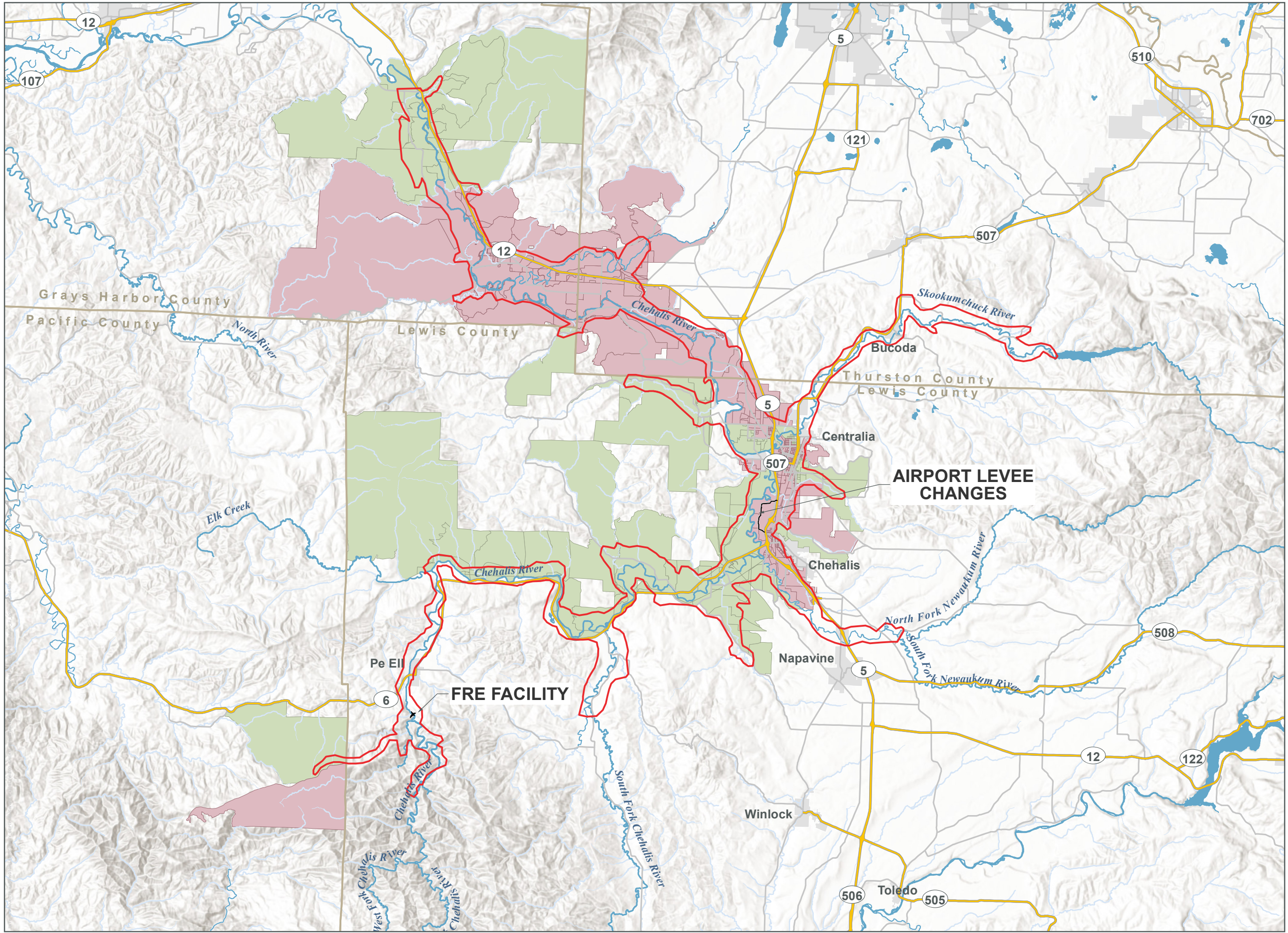
7.0 Abbreviations List

Anchor QEA	Anchor QEA, LLC
cfs	cubic feet per second
District	Chehalis River Basin Flood Control Zone District
Ecology	Washington Department of Ecology
EIS	environmental impact statement
FRE	flood retention expandable
HDR	HDR Engineering, Inc.
NEPA	National Environmental Policy Act
proposed project	Chehalis River Basin Flood Damage Reduction Project
SEPA	State Environmental Policy Act
TM	technical memorandum
USEPA	U.S. Environmental Protection Act
WSE	Watershed Sciences and Engineering
WSEL	Water Surface Elevation



Attachment A: Map Book

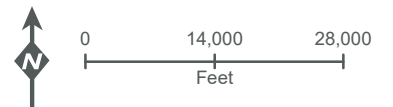
**FIGURE 1
ENVIRONMENTAL
JUSTICE
POPULATIONS**



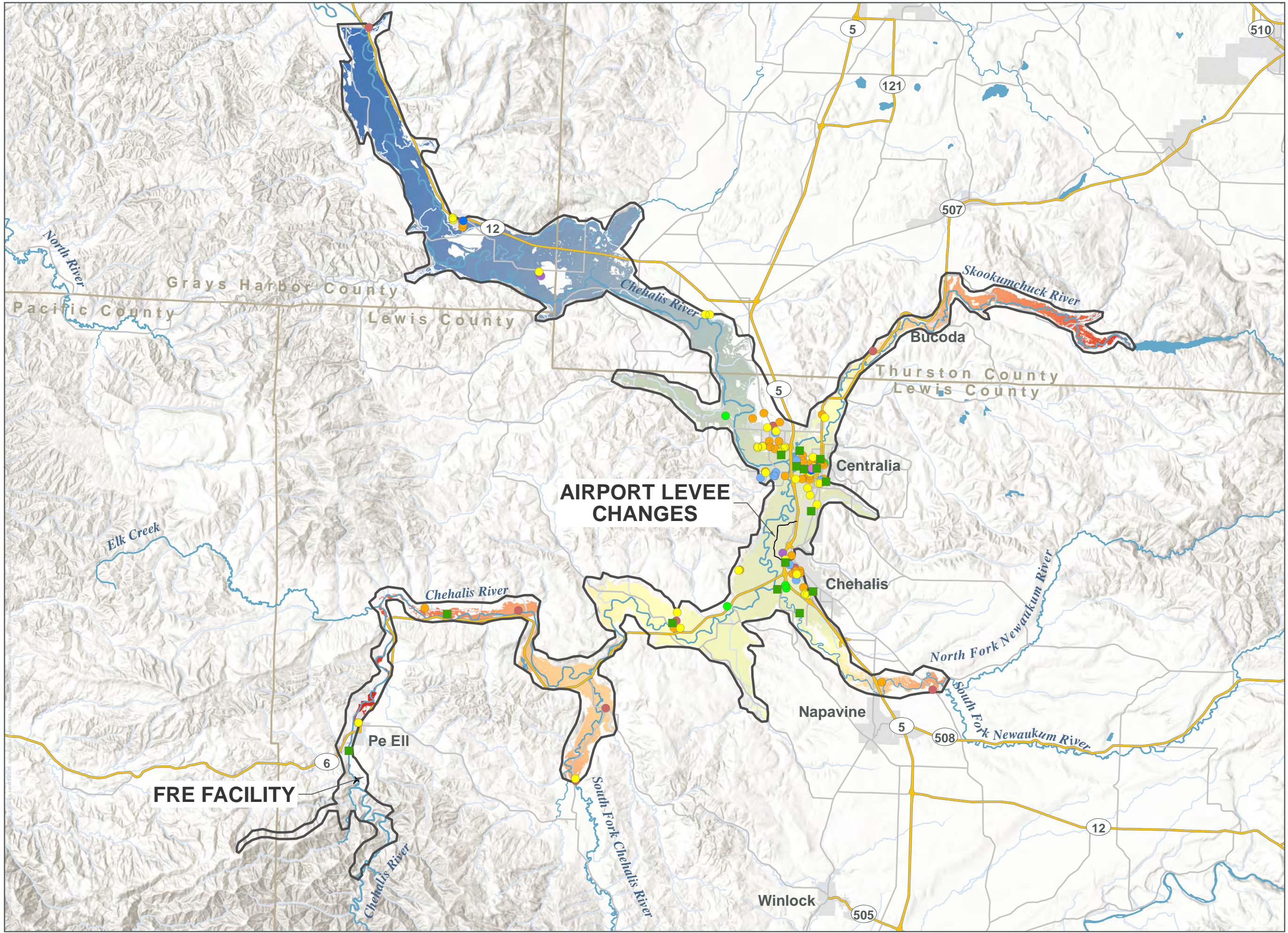
- Streams
- Roads
- City Boundary
- County Boundary
- Study Area
- EJ Population
- No
- Yes

**AIRPORT LEVEE
CHANGES**

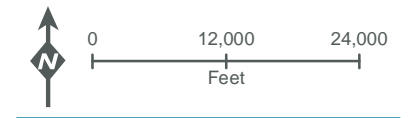
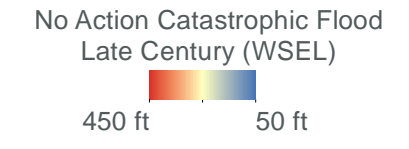
FRE FACILITY



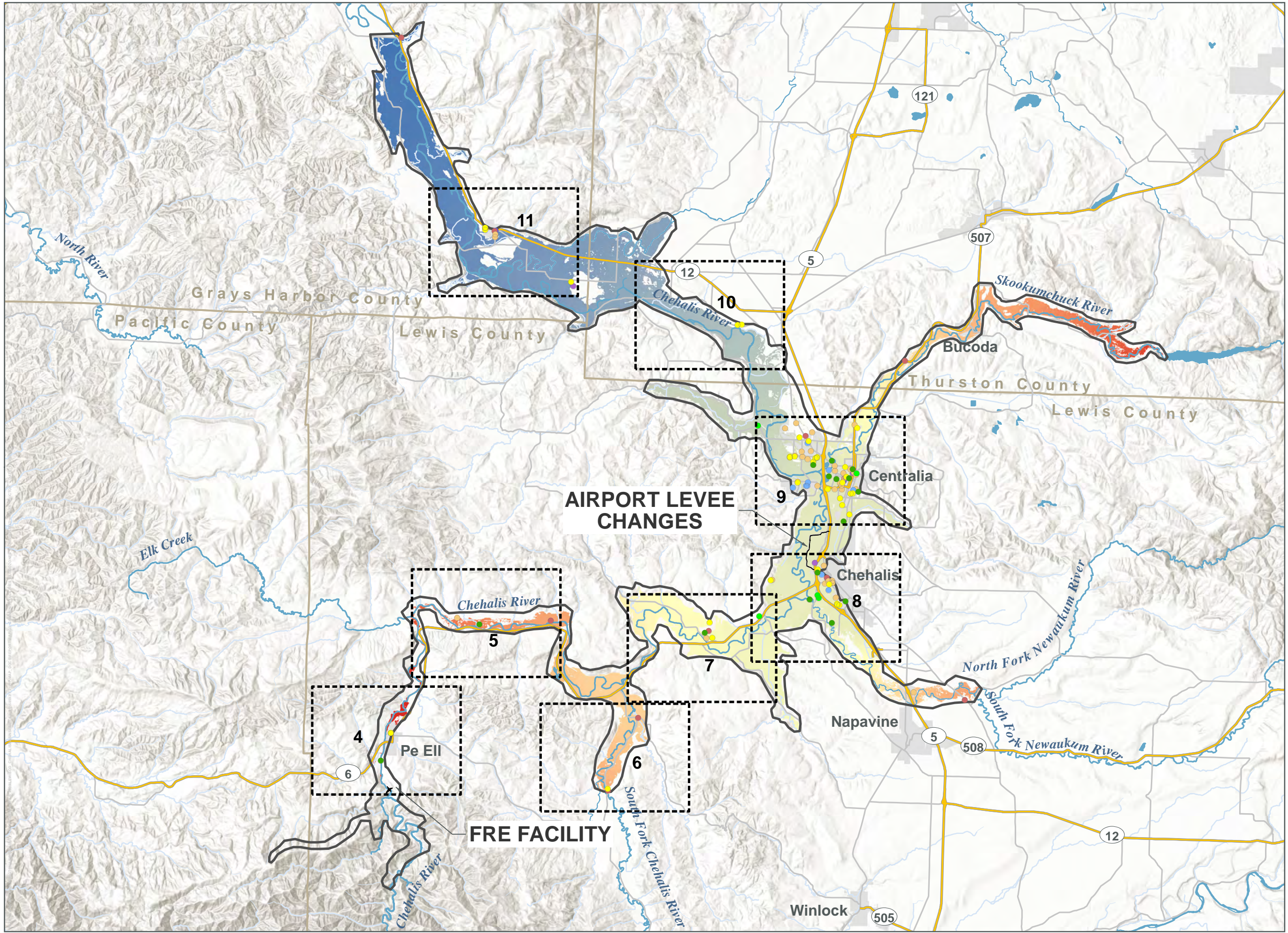
**FIGURE 2
COMMUNITY FACILITIES
IMPACTED BY NO
ACTION FLOOD LATE
CENTURY WSEL**



- Community Facilities**
- Park
 - Schools & Day Care
 - College
 - Library
 - Hospitals & Nursing Home
 - Museum
 - Place of worship
 - Fire Stations
 - Police Station
 - Streams
 - Roads
 - City Boundary
 - County Boundary
 - Study Area



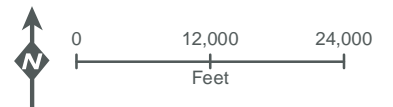
**FIGURE 3
COMMUNITY FACILITIES
AND LATE CENTURY
FLOOD WSEL
OVERVIEW**



- Community Facilities**
- Park
 - Library
 - College
 - Schools & Day Care
 - Hospitals & Nursing Home
 - Museum
 - Place of worship
 - Fire Stations
 - Police Station
- Streams
— Roads
— City Boundary
— County Boundary
— Study Area

No Action Catastrophic Flood
Late Century (WSEL)


450 ft █ █ 50 ft



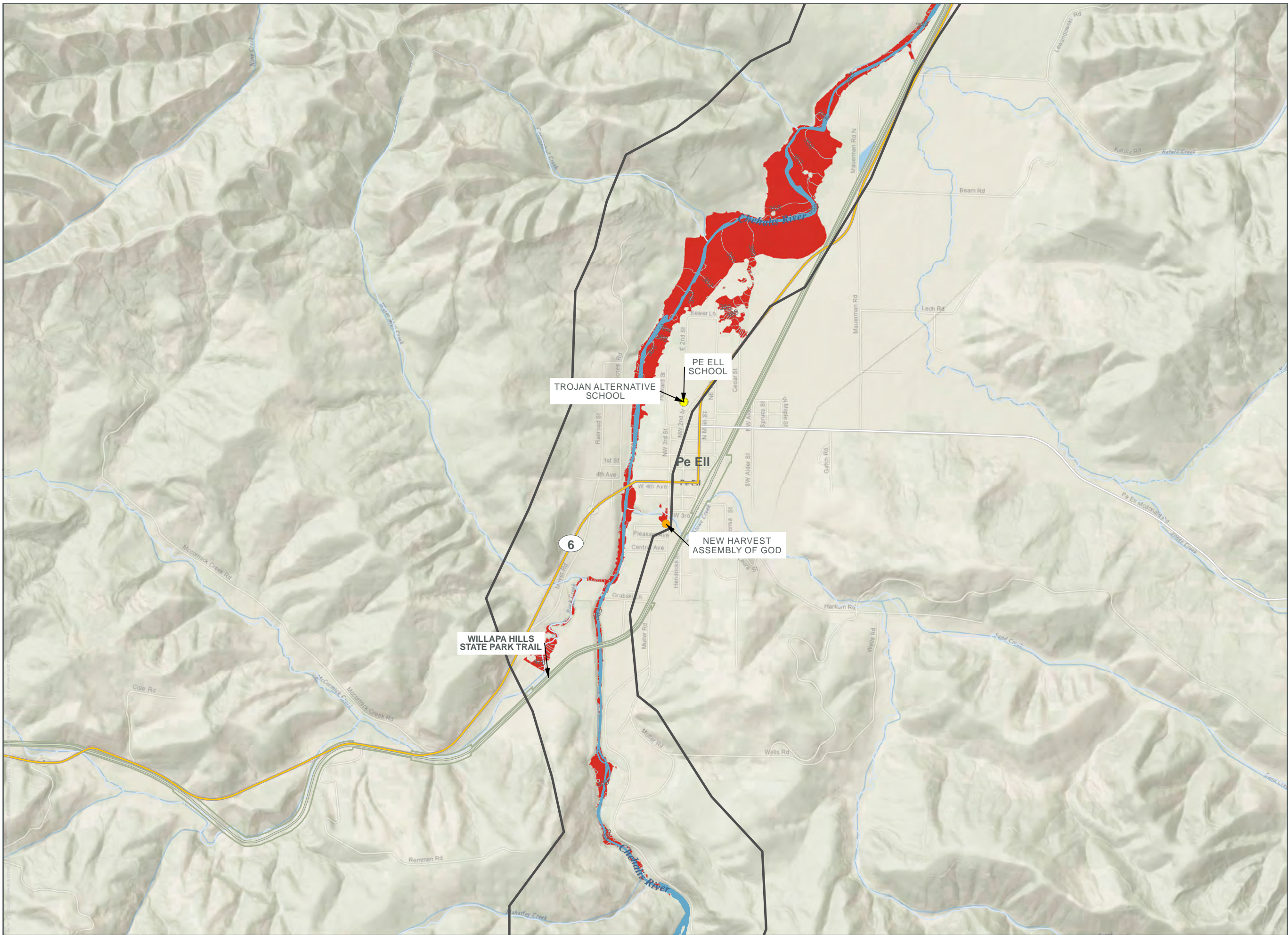
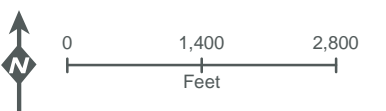
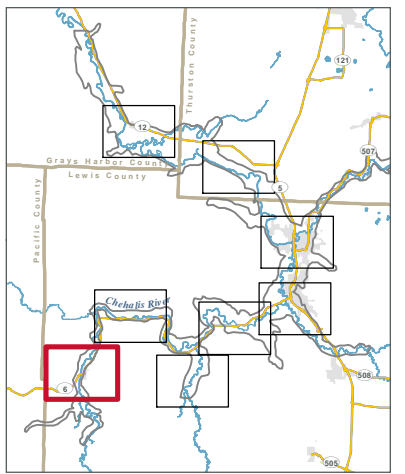
**FIGURE 4
COMMUNITY FACILITIES
IMPACTED BY LATE
CENTURY FLOOD WSEL**

- Community Facilities
- Park
 - Schools & Day Care
 - Place of worship
 - Streams
 - Roads
 - State Trail
 - State Park Boundary
 - City Boundary
 - County Boundary
 - Study Area
 - 1ft Contour WSEL

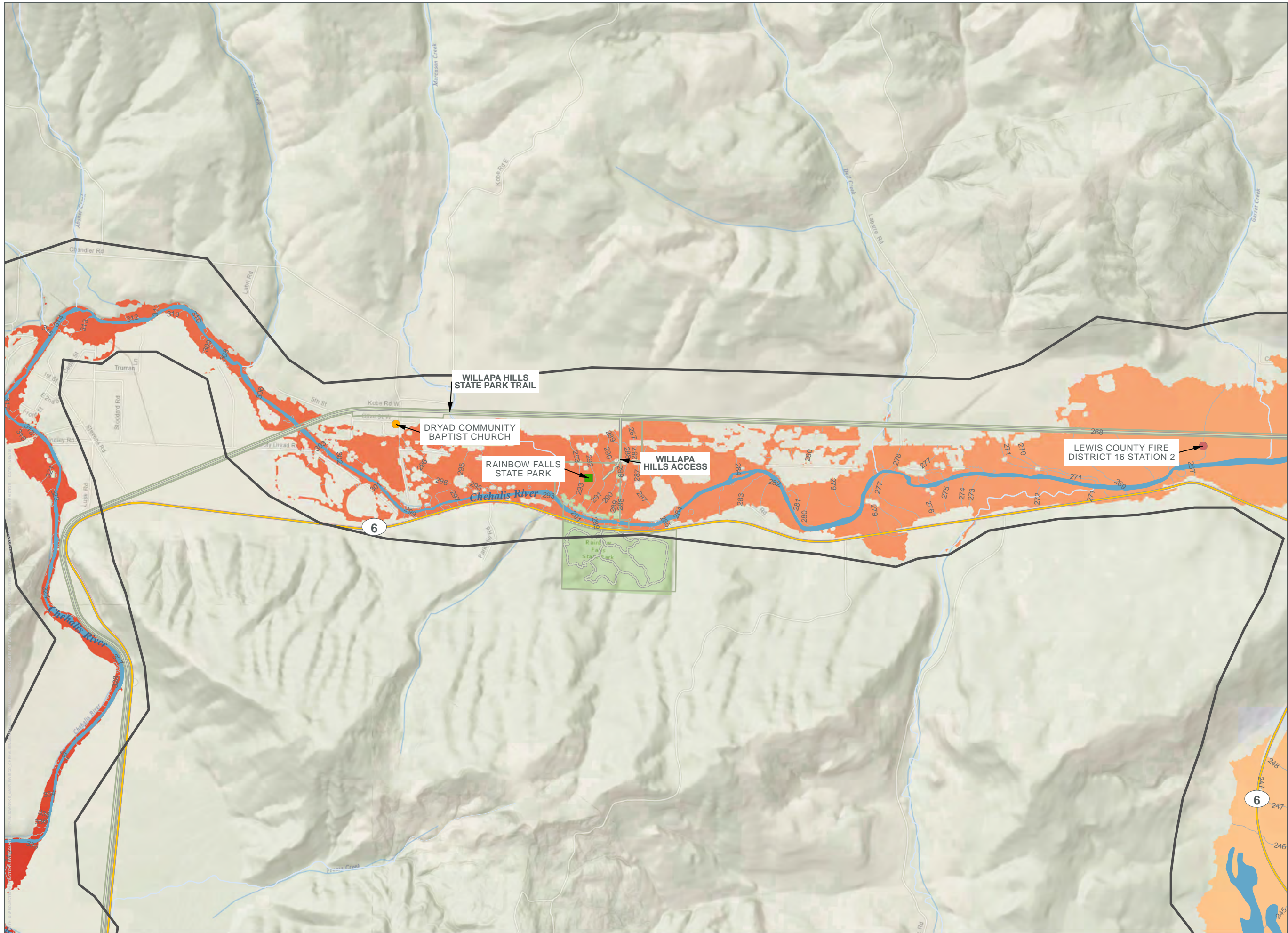
No Action Catastrophic Flood
Late Century (WSEL)



450 ft 50 ft



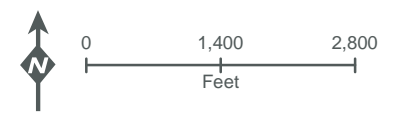
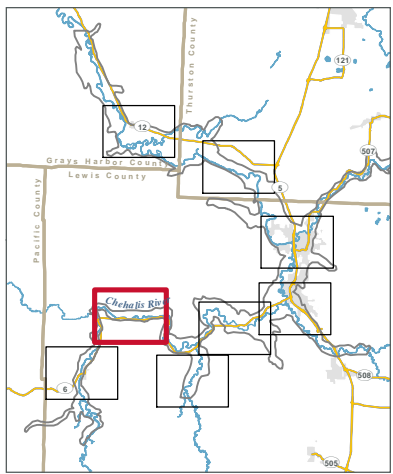
**FIGURE 5
COMMUNITY FACILITIES
IMPACTED BY LATE
CENTURY FLOOD WSEL**



Community Facilities

- Park
- Place of worship
- Fire Stations
- Streams
- Roads
- State Trail
- State Park Boundary
- County Boundary
- Study Area
- 1ft Contour WSEL


**No Action Catastrophic Flood
Late Century (WSEL)**



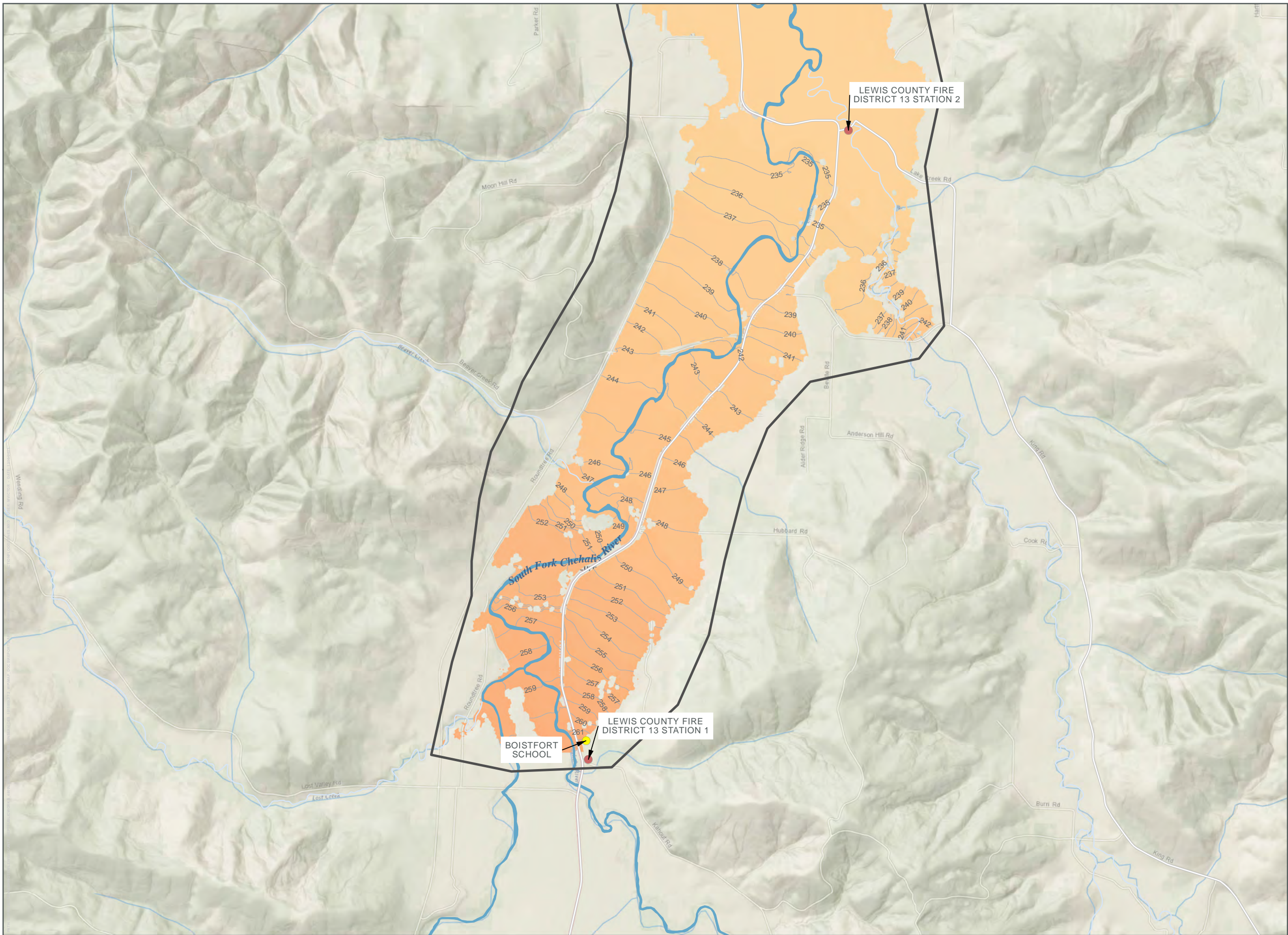
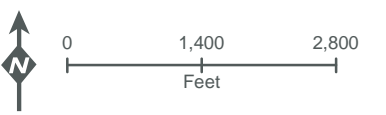
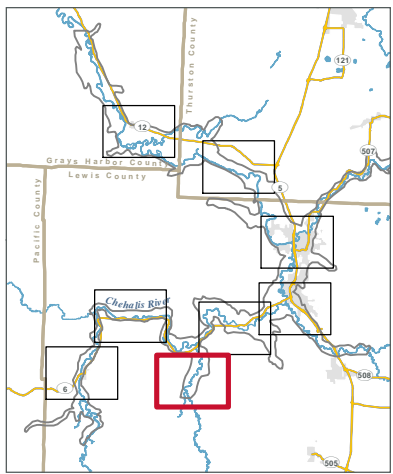
**FIGURE 6
COMMUNITY FACILITIES
IMPACTED BY LATE
CENTURY FLOOD WSEL**

- Community Facilities
- Schools & Day Care
 - Fire Stations
 - Streams
 - State Trail
 - State Park Boundary
 - County Boundary
 - Study Area
 - 1ft Contour WSEL

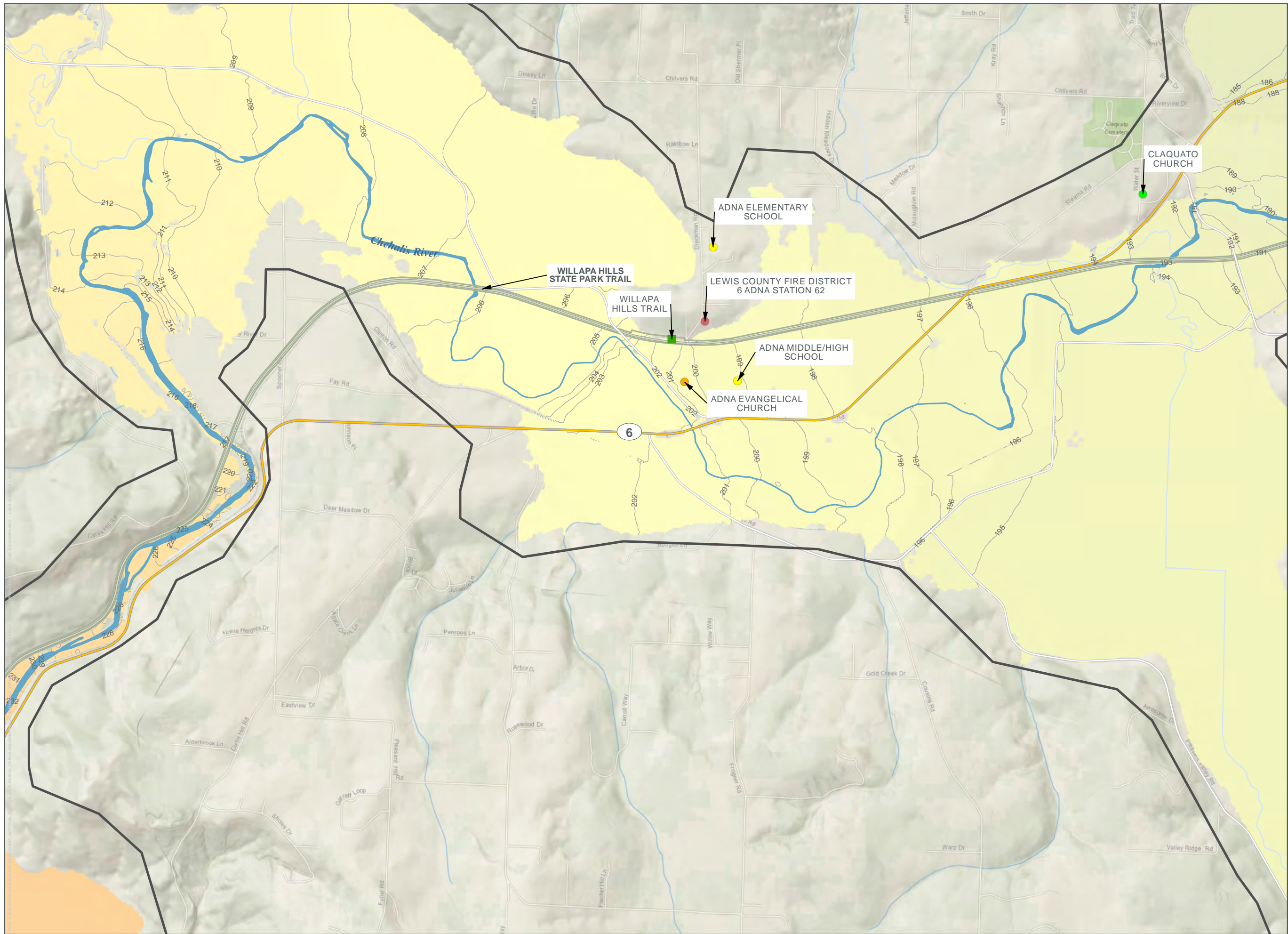
No Action Catastrophic Flood
Late Century (WSEL)



450 ft 50 ft



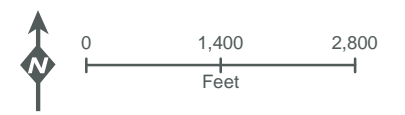
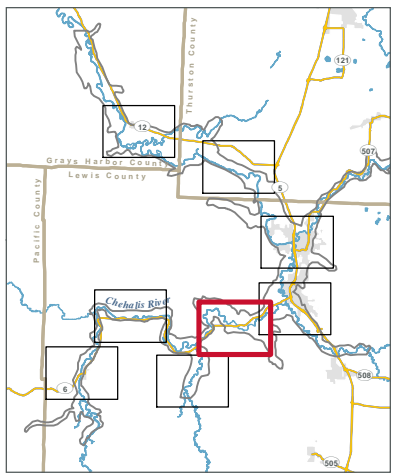
**FIGURE 7
COMMUNITY FACILITIES
IMPACTED BY LATE
CENTURY FLOOD WSEL**



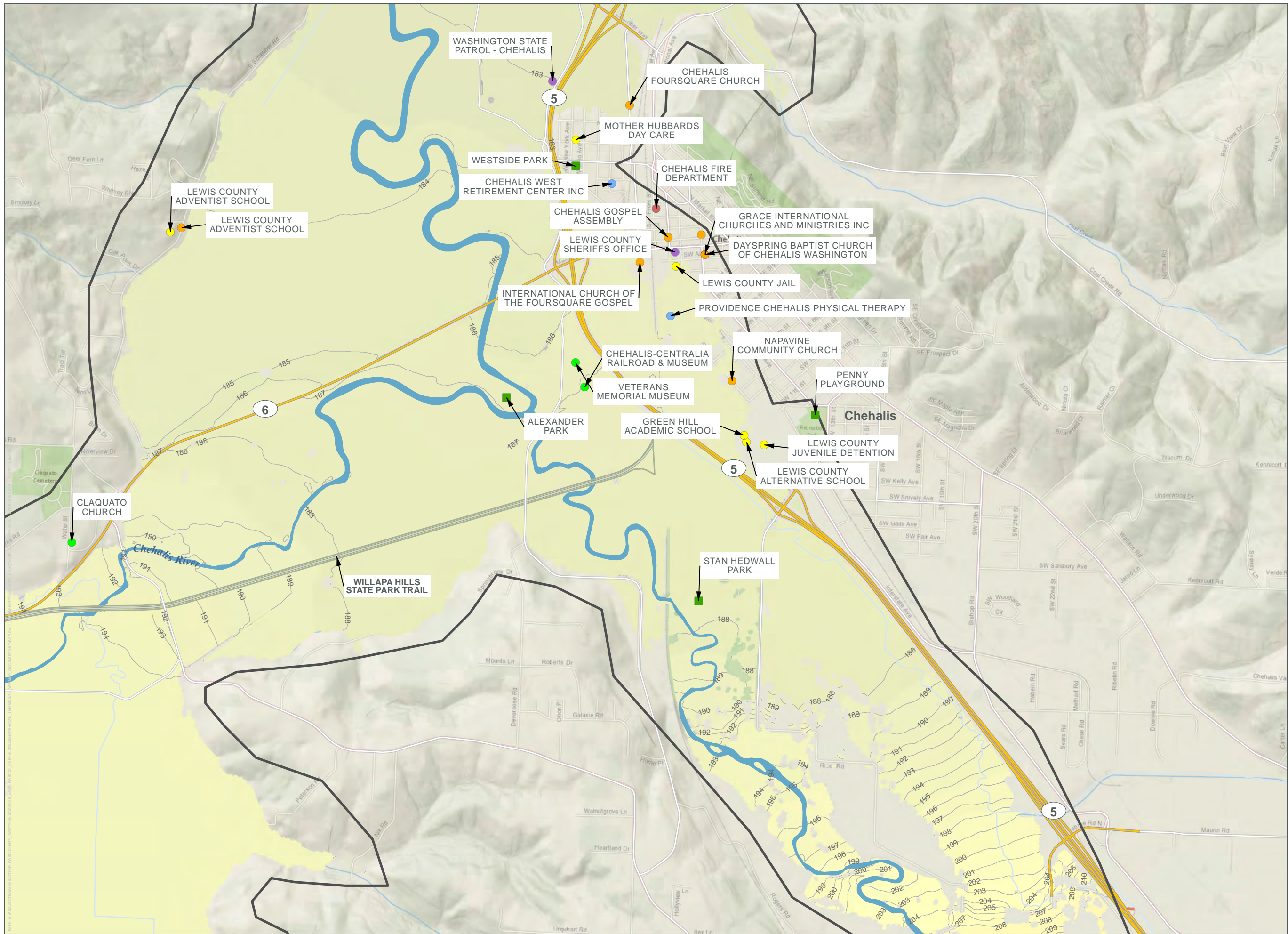
Community Facilities

- Park
- Schools & Day Care
- Museum
- Place of worship
- Fire Stations
- Streams
- Roads
- State Trail
- State Park Boundary
- County Boundary
- Study Area
- 1ft Contour WSEL

**No Action Catastrophic Flood
Late Century (WSEL)**



**FIGURE 8
COMMUNITY FACILITIES
IMPACTED BY LATE
CENTURY FLOOD WSEL**

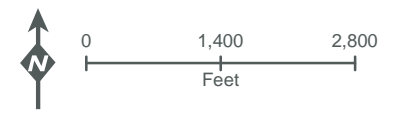
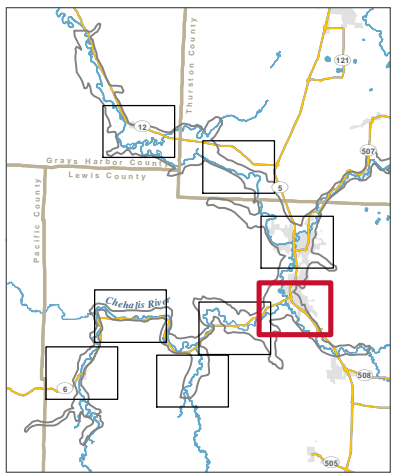


- Community Facilities**
- Park
 - Schools & Day Care
 - Hospitals & Nursing Home
 - Museum
 - Place of worship
 - Fire Stations
 - Police Station
 - Streams
 - Roads
 - State Trail
 - State Park Boundary
 - City Boundary
 - County Boundary
 - Study Area
 - 1ft Contour WSEL

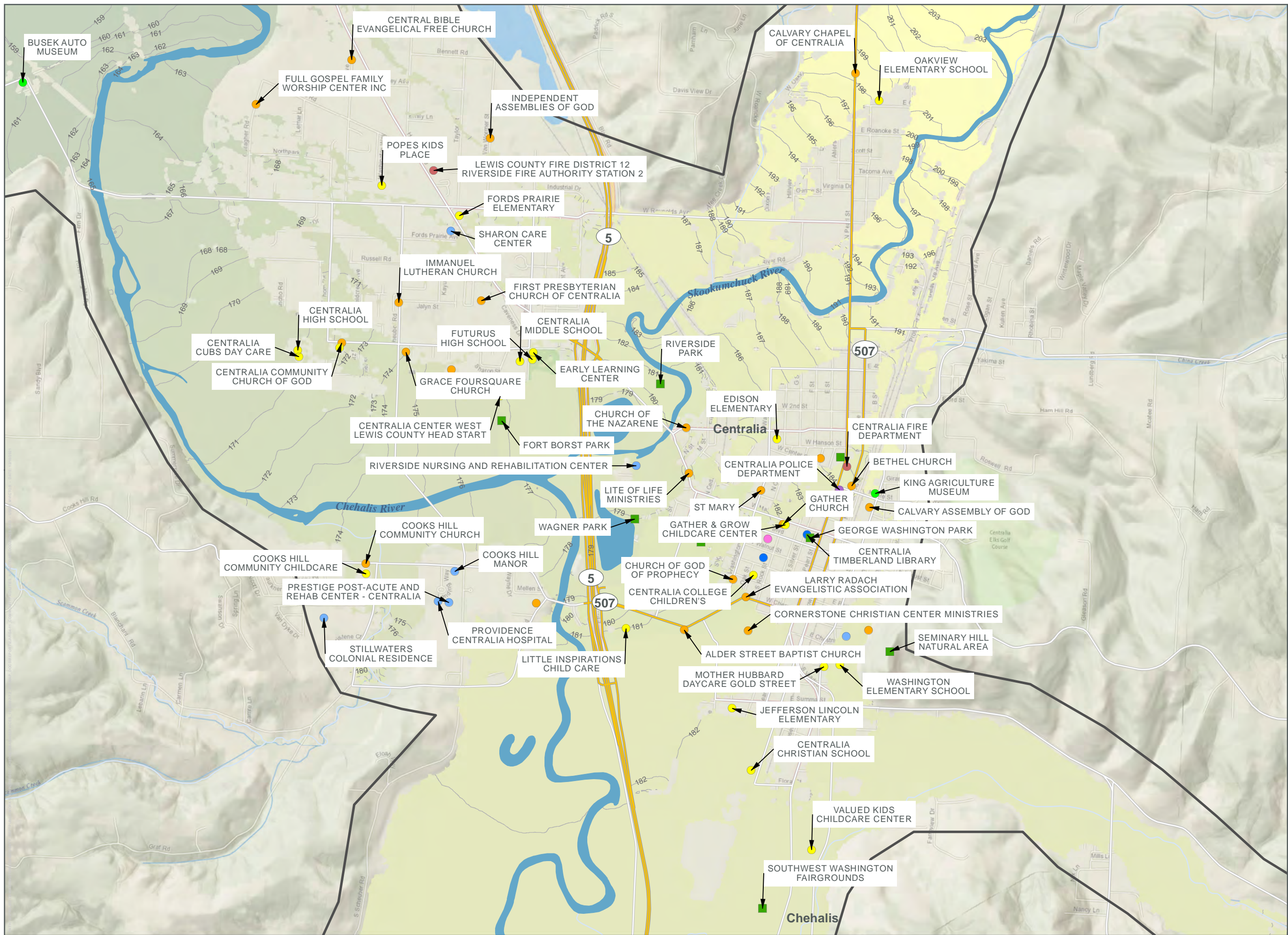
No Action Catastrophic Flood
Late Century (WSEL)

■ ■ ■ ■ ■

450 ft 50 ft



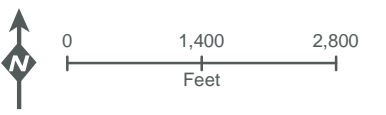
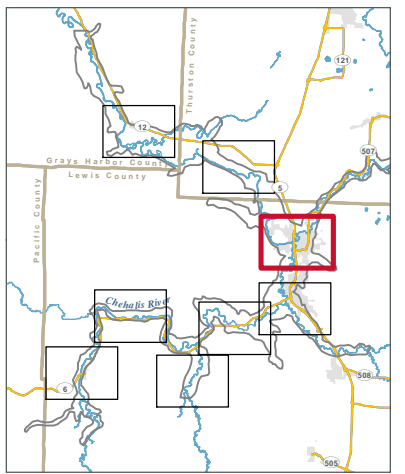
**FIGURE 9
COMMUNITY FACILITIES
IMPACTED BY LATE
CENTURY FLOOD WSEL**



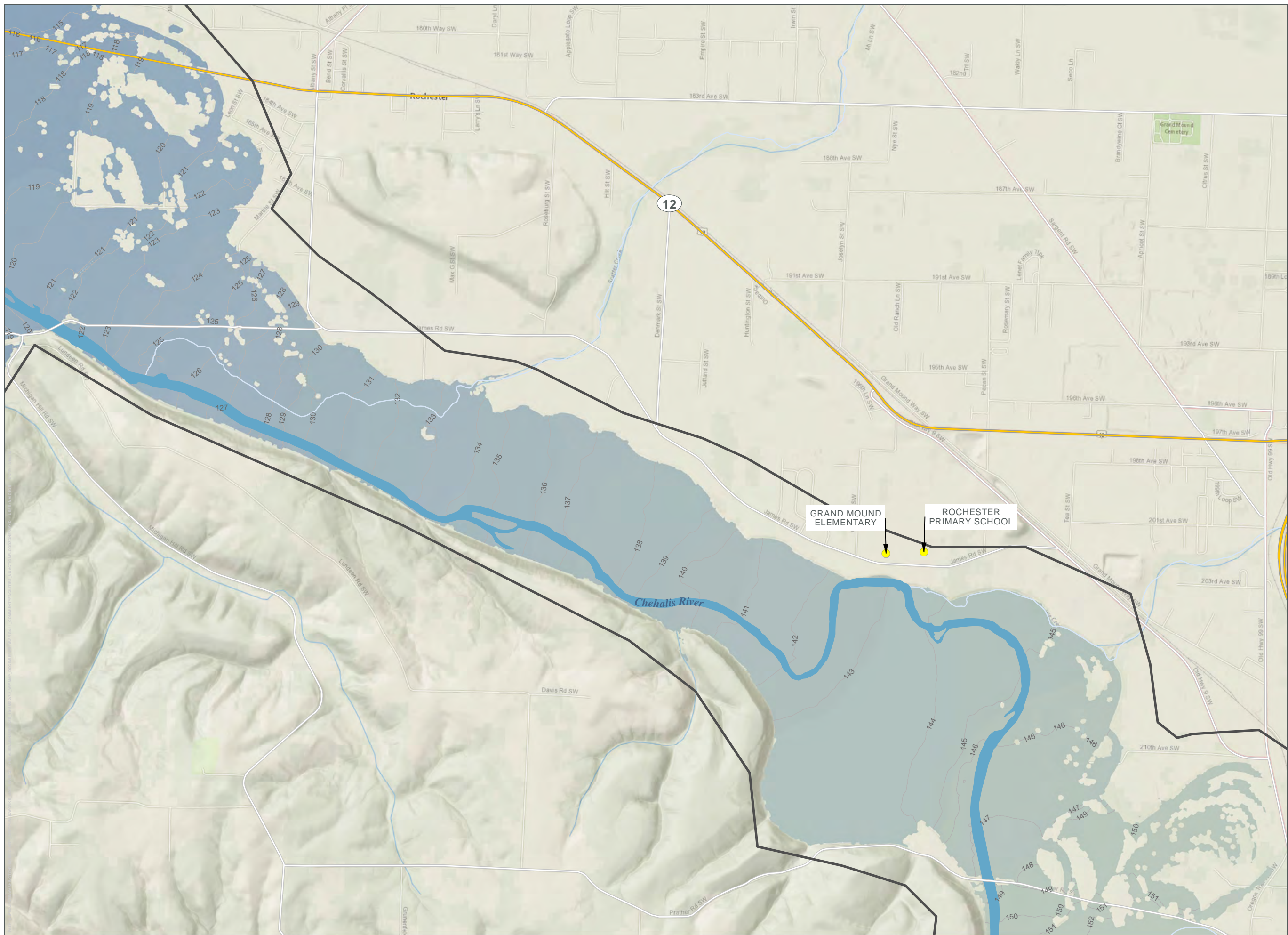
- Community Facilities**
- Park
 - Library
 - College
 - Schools & Day Care
 - Hospitals & Nursing Home
 - Museum
 - Place of worship
 - Fire Stations
 - Police Station
 - Streams
 - Roads
 - State Trail
 - State Park Boundary
 - City Boundary
 - County Boundary
 - Study Area
 - 1ft Contour WSEL

**No Action Catastrophic Flood
Late Century (WSEL)**

■ 450 ft ■ 50 ft



**FIGURE 10
COMMUNITY FACILITIES
IMPACTED BY LATE
CENTURY FLOOD WSEL**



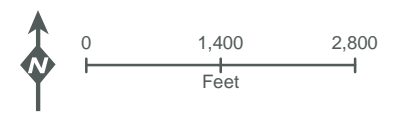
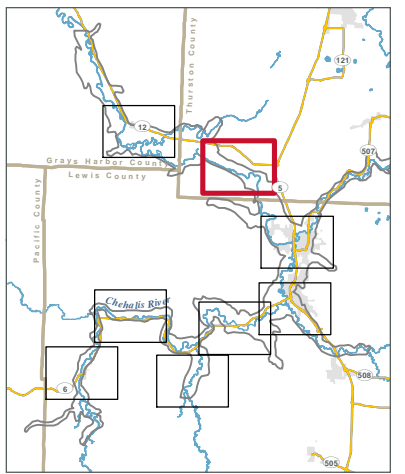
- Community Facilities**
- Schools & Day Care
 - Streams
 - Roads
 - State Trail
 - State Park Boundary
 - County Boundary
 - Study Area
 - 1ft Contour WSEL

GRAND MOUND
ELEMENTARY

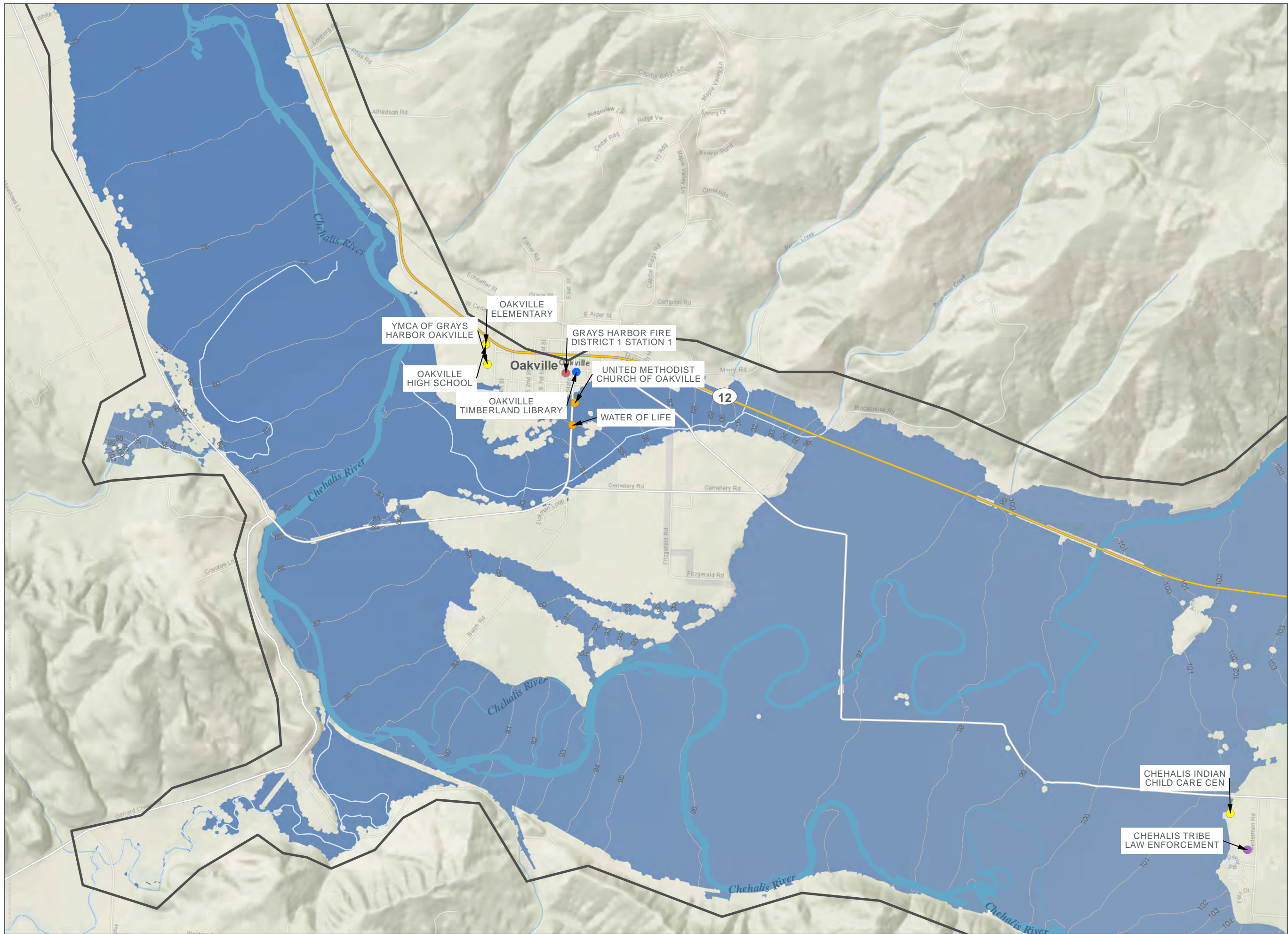
ROCHESTER
PRIMARY SCHOOL

No Action Catastrophic Flood
Late Century (WSEL)

450 ft 50 ft



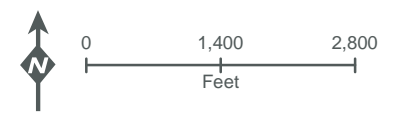
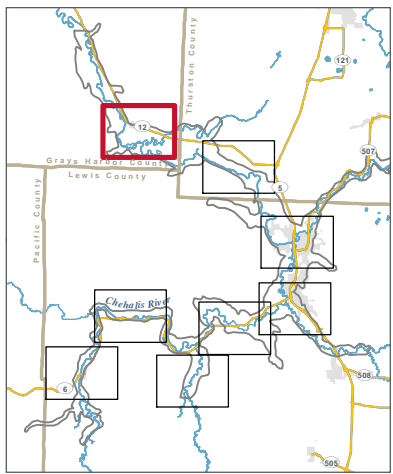
**FIGURE 11
COMMUNITY FACILITIES
IMPACTED BY LATE
CENTURY FLOOD WSEL**



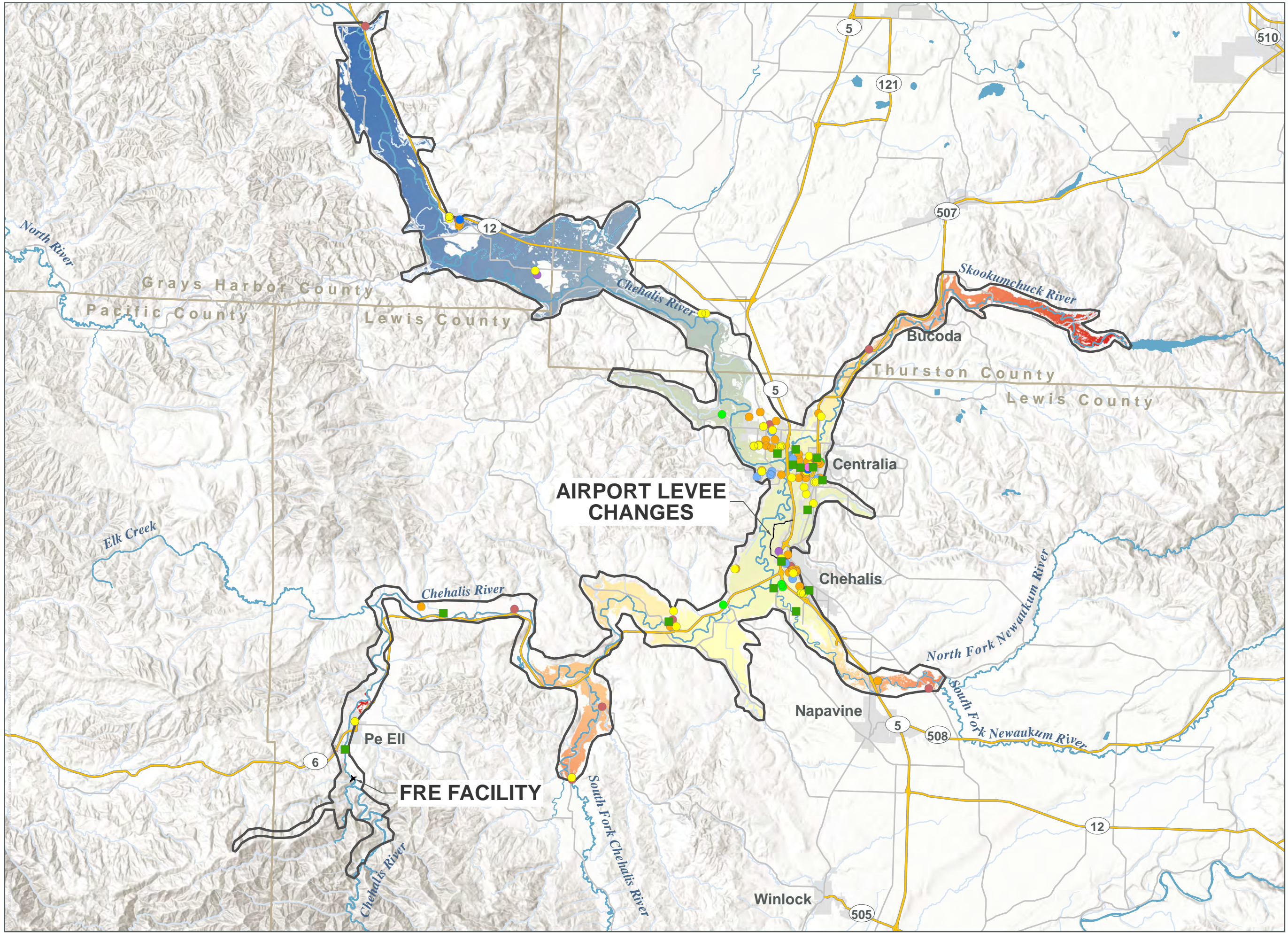
Community Facilities

- Library
- Schools & Day Care
- Place of worship
- Fire Stations
- Police Station
- Streams
- Roads
- State Trail
- State Park Boundary
- City Boundary
- County Boundary
- Study Area
- 1ft Contour WSEL

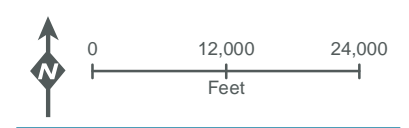
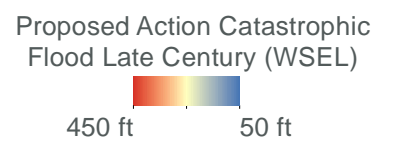
**No Action Catastrophic Flood
Late Century (WSEL)**



**FIGURE 12
COMMUNITY FACILITIES
IMPACTED BY PROPOSED
ACTION FLOOD LATE
CENTURY WSEL**



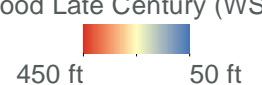
- Community Facilities**
- Park
 - Library
 - College
 - Schools & Day Care
 - Hospitals & Nursing Home
 - Museum
 - Place of worship
 - Fire Stations
 - Police Station
 - Streams
 - Roads
 - City Boundary
 - County Boundary
 - Study



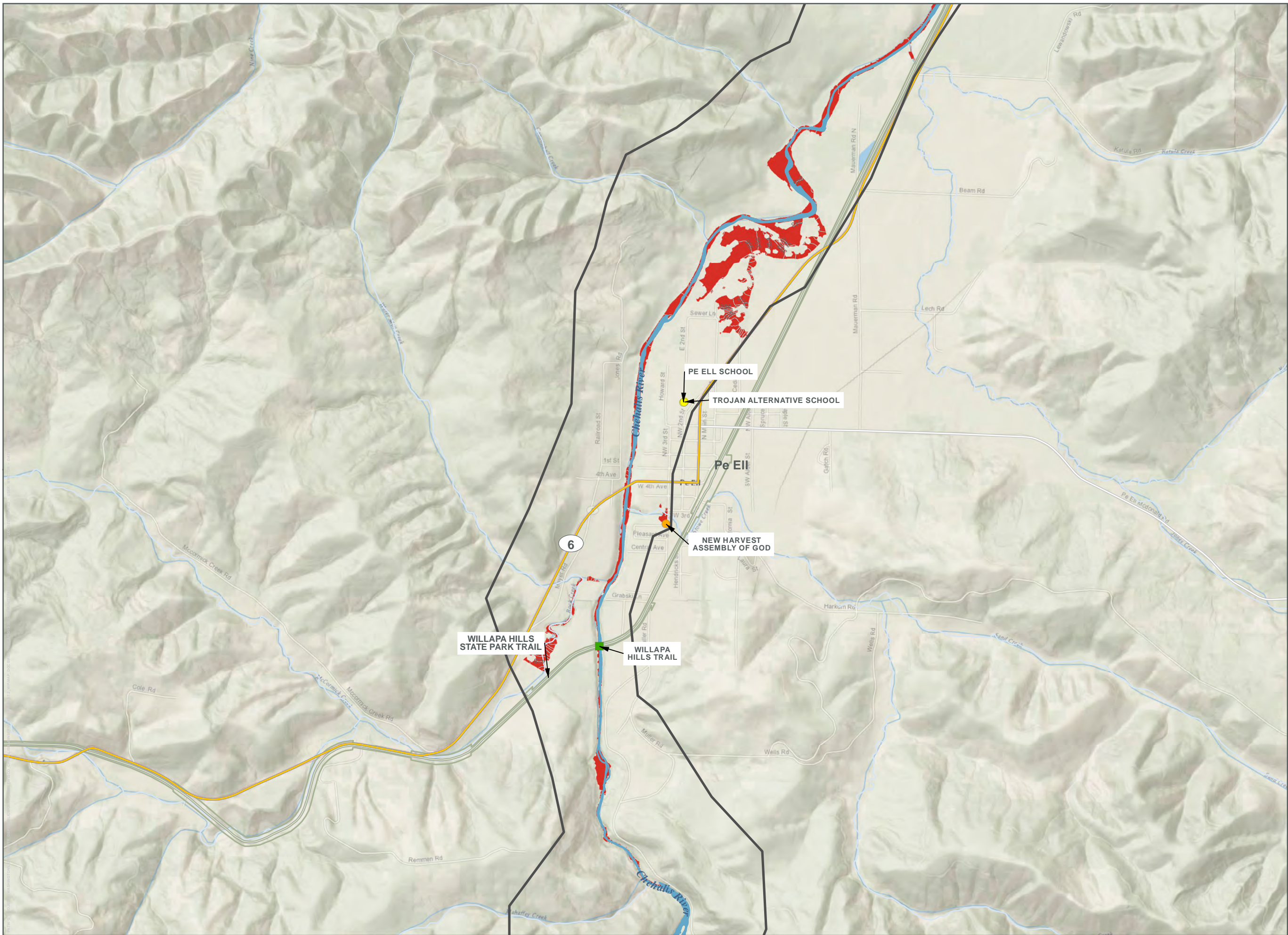
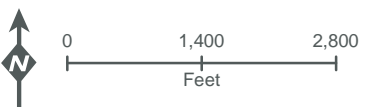
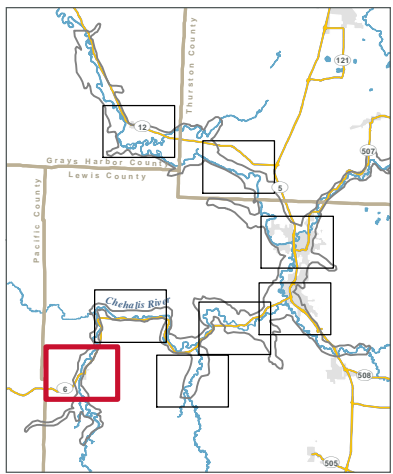
**FIGURE 13
COMMUNITY FACILITIES
IMPACTED BY LATE
CENTURY FLOOD WSEL**

- Community Facilities**
- Park
 - Schools & Day Care
 - Place of worship
 - Streams
 - Roads
 - State Trail
 - State Park Boundary
 - County Boundary
 - Study Area
 - 1ft Contour WSEL

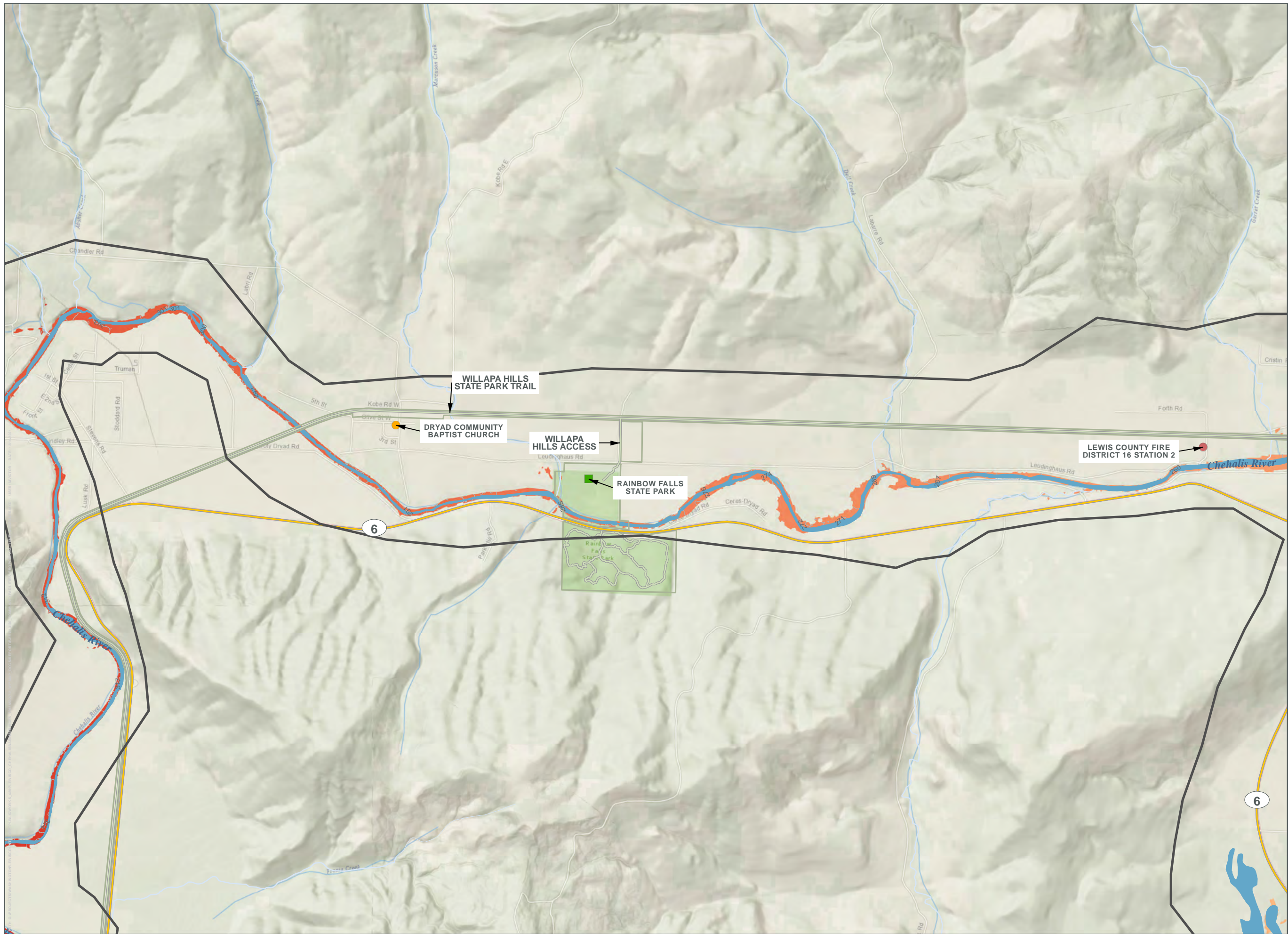
**Proposed Action Catastrophic
Flood Late Century (WSEL)**



450 ft 50 ft



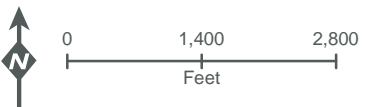
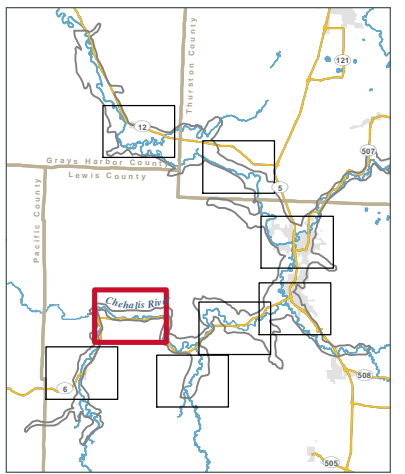
**FIGURE 14
COMMUNITY FACILITIES
IMPACTED BY LATE
CENTURY FLOOD WSEL**



- Community Facilities**
- Park
 - Place of worship
 - Fire Stations
 - Streams
 - Roads
 - State Trail
 - State Park Boundary
 - County Boundary
 - Study Area
 - 1ft Contour WSEL

**Proposed Action Catastrophic
Flood Late Century (WSEL)**

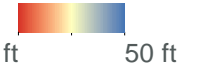
450 ft 50 ft



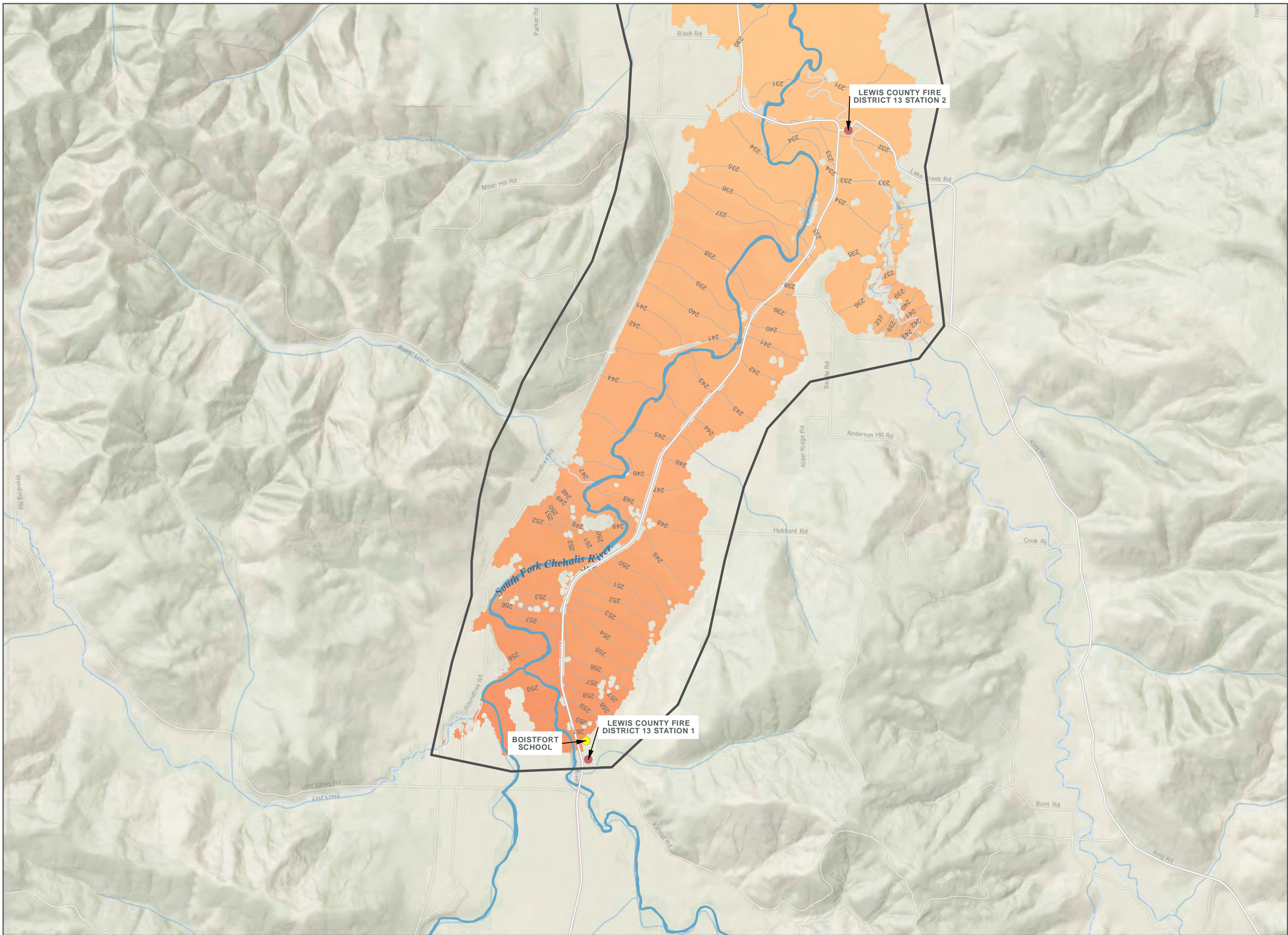
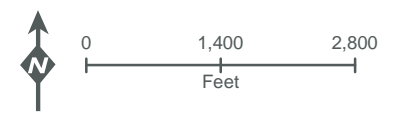
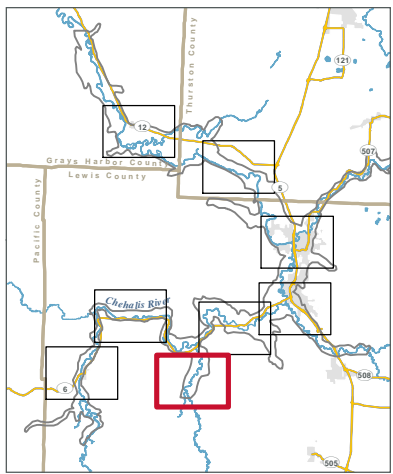
**FIGURE 15
COMMUNITY FACILITIES
IMPACTED BY LATE
CENTURY FLOOD WSEL**

- Community Facilities
- Schools & Day Care
 - Fire Stations
 - Streams
 - State Trail
 - State Park Boundary
 - County Boundary
 - Study Area
 - 1ft Contour WSEL

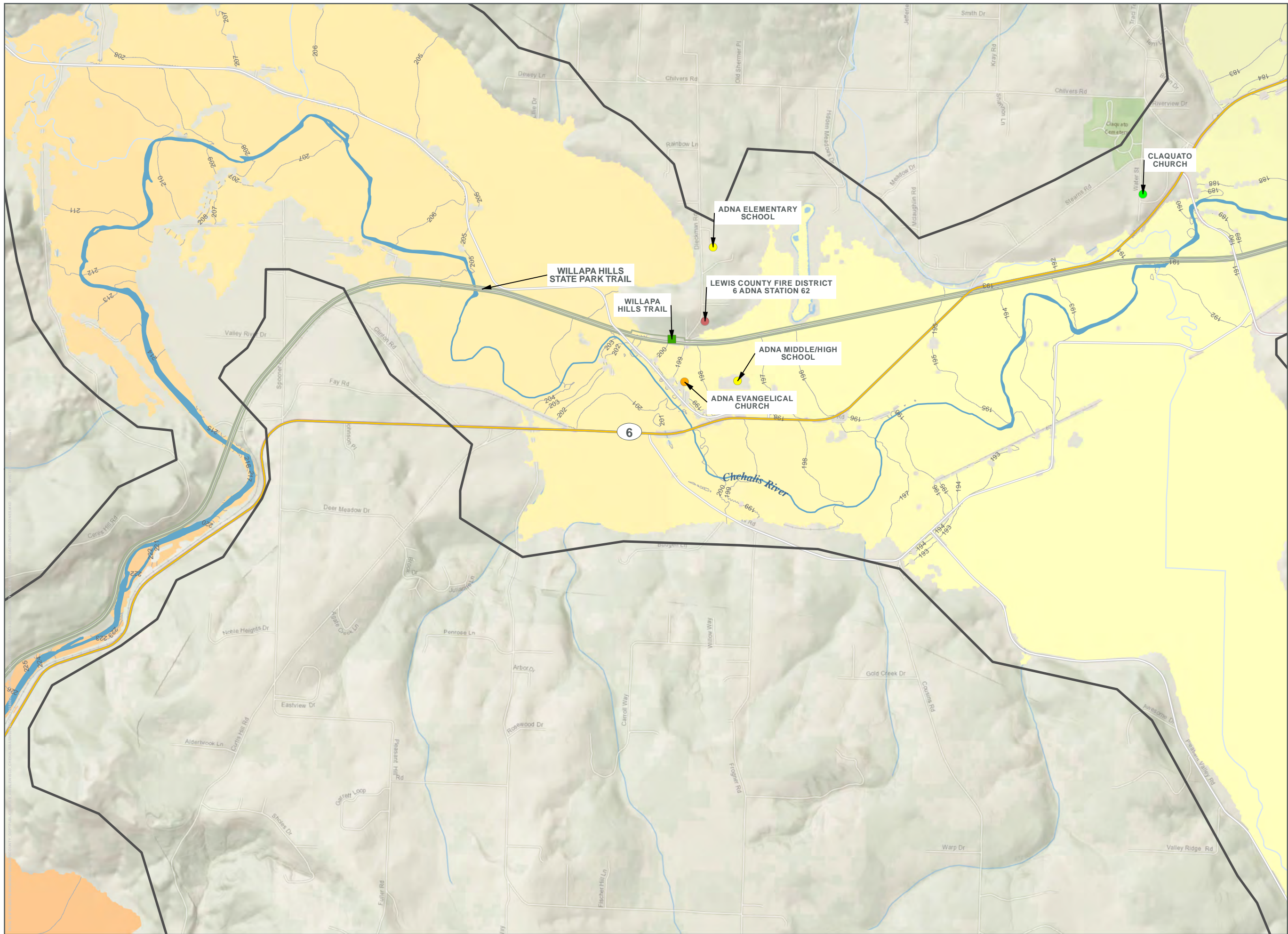
Proposed Action Catastrophic
Flood Late Century (WSEL)



450 ft 50 ft



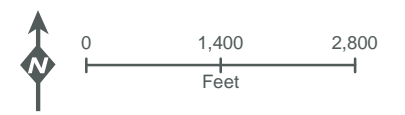
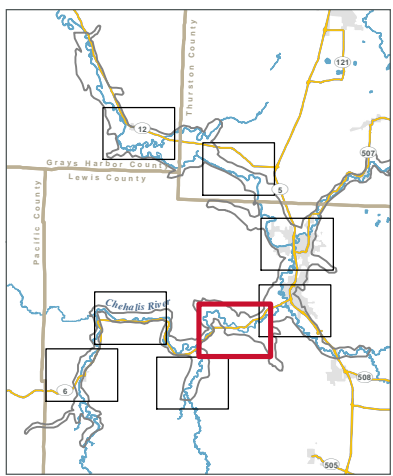
**FIGURE 16
COMMUNITY FACILITIES
IMPACTED BY LATE
CENTURY FLOOD WSEL**



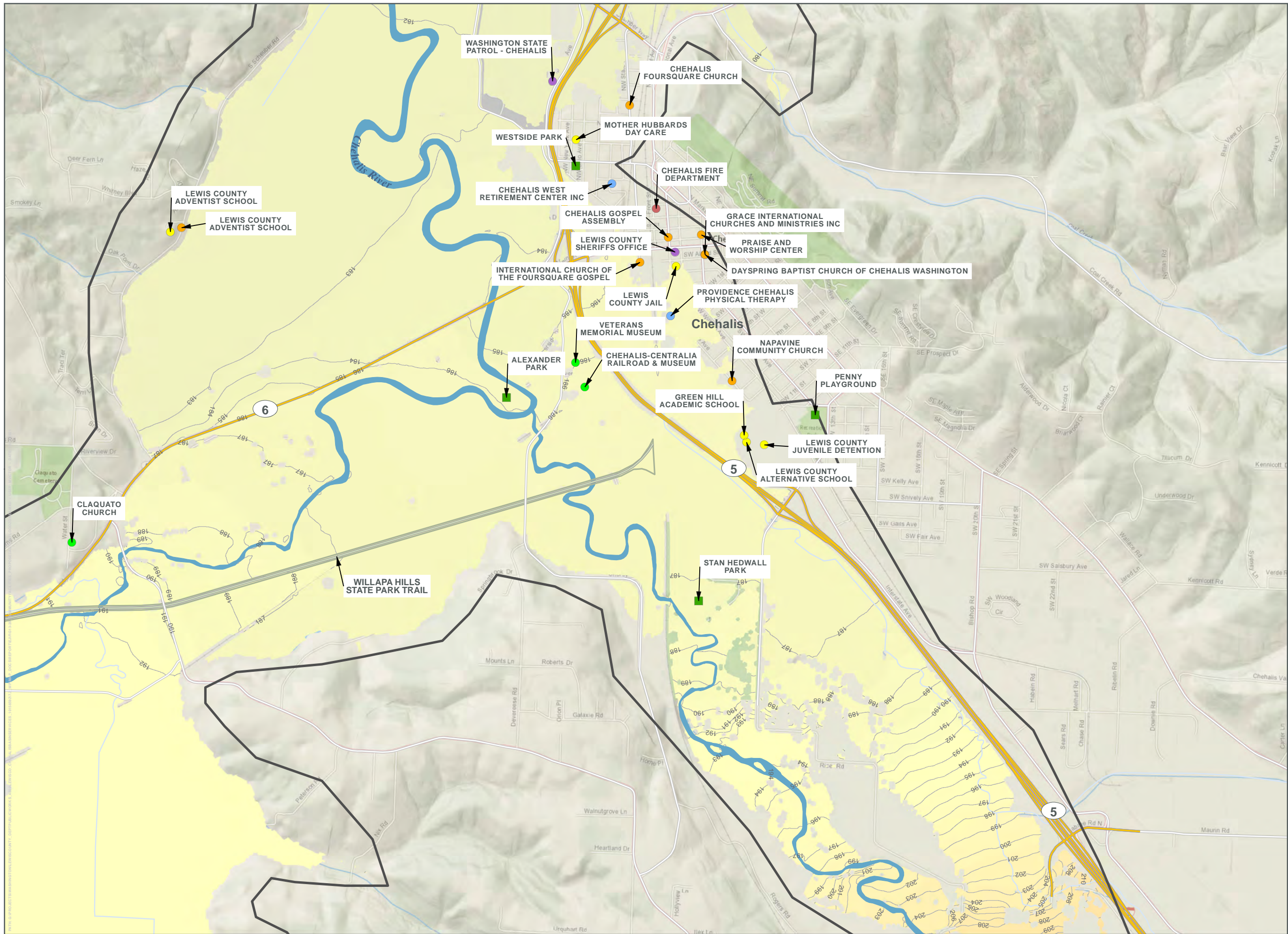
Community Facilities

- Park
- Schools & Day Care
- Museum
- Place of worship
- Fire Stations
- Streams
- Roads
- State Trail
- State Park Boundary
- County Boundary
- Study Area
- 1ft Contour WSEL

**Proposed Action Catastrophic
Flood Late Century (WSEL)**



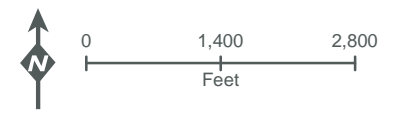
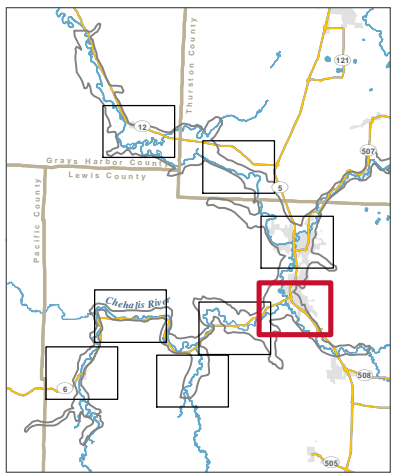
**FIGURE 17
COMMUNITY FACILITIES
IMPACTED BY LATE
CENTURY FLOOD WSEL**



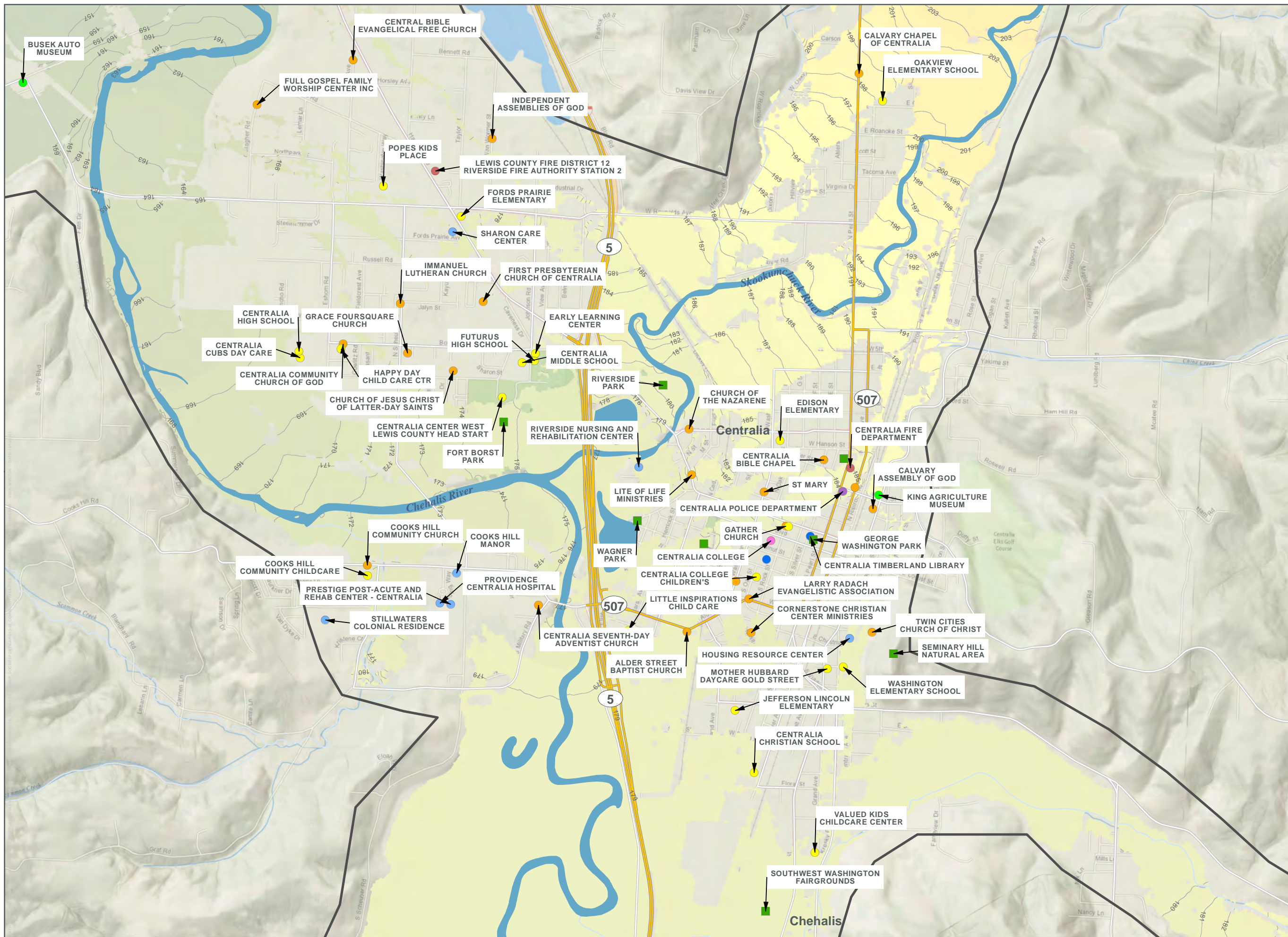
- Community Facilities**
- Park
 - Schools & Day Care
 - Hospitals & Nursing Home
 - Museum
 - Place of worship
 - Fire Stations
 - Police Station
 - Streams
 - Roads
 - State Trail
 - State Park Boundary
 - County Boundary
 - Study Area
 - 1ft Contour WSEL

**Proposed Action Catastrophic
Flood Late Century (WSEL)**

■ 450 ft ■ 50 ft



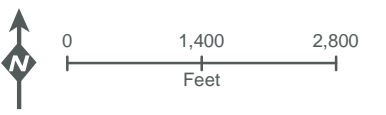
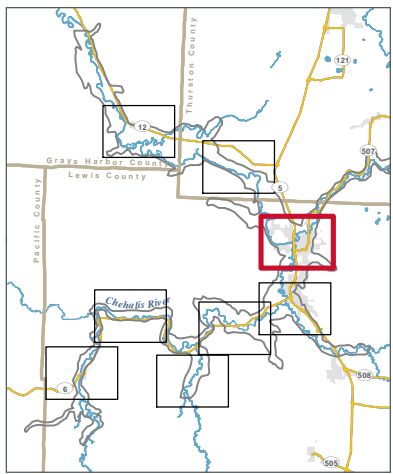
**FIGURE 18
COMMUNITY FACILITIES
IMPACTED BY LATE
CENTURY FLOOD WSEL**



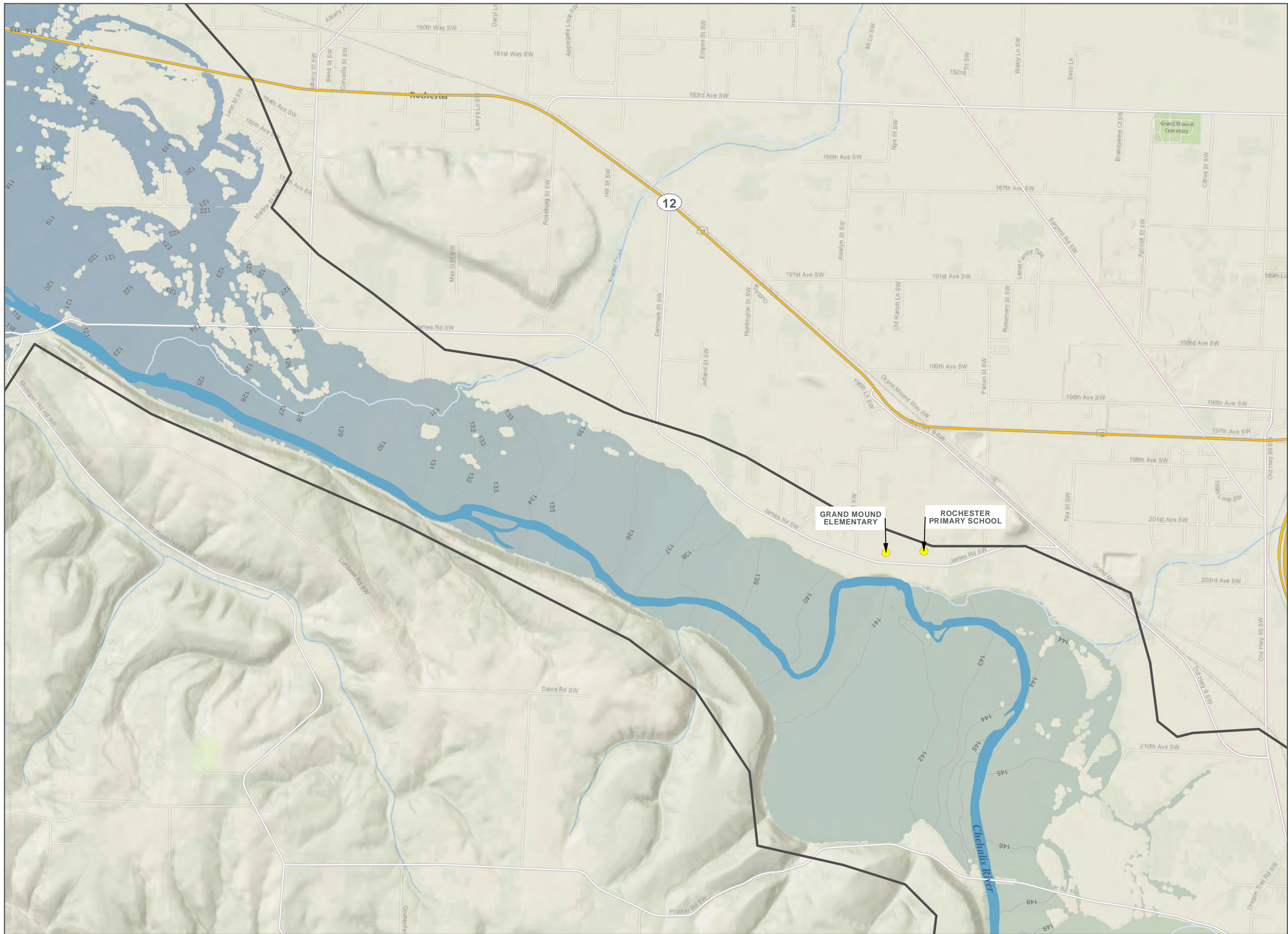
- Community Facilities**
- Park
 - Library
 - College
 - Schools & Day Care
 - Hospitals & Nursing Home
 - Museum
 - Place of worship
 - Fire Stations
 - Police Station
 - Streams
 - Roads
 - State Trail
 - State Park Boundary
 - County Boundary
 - Study Area
 - 1ft Contour WSEL

**Proposed Action Catastrophic
Flood Late Century (WSEL)**

450 ft 50 ft



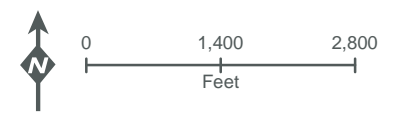
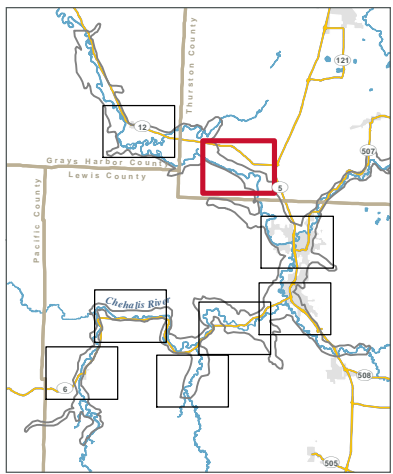
**FIGURE 19
COMMUNITY FACILITIES
IMPACTED BY LATE
CENTURY FLOOD WSEL**



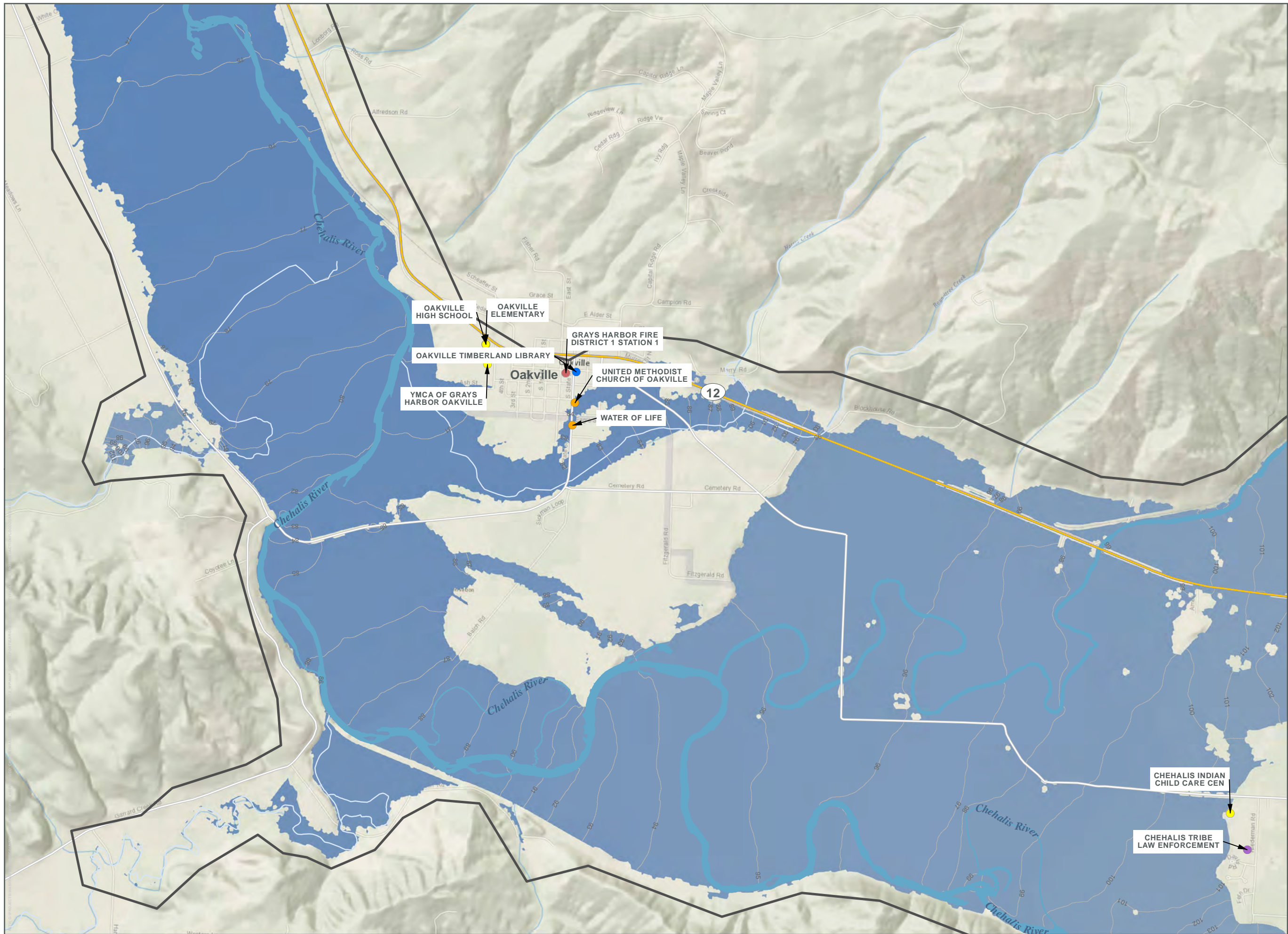
- Community Facilities**
- Schools & Day Care
 - Streams
 - Roads
 - State Trail
 - State Park Boundary
 - County Boundary
 - Study Area
 - 1ft Contour WSEL

**Proposed Action Catastrophic
Flood Late Century (WSEL)**

450 ft 50 ft



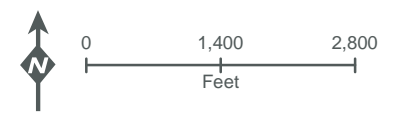
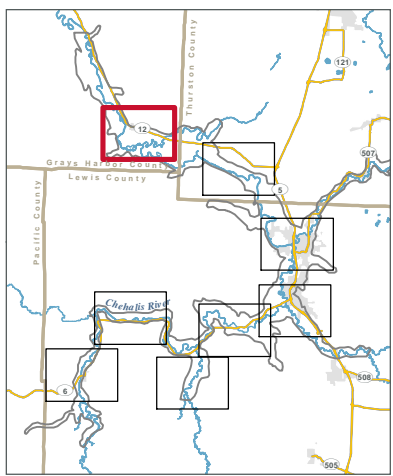
**FIGURE 20
COMMUNITY FACILITIES
IMPACTED BY LATE
CENTURY FLOOD WSEL**












Community Facilities

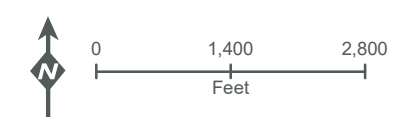
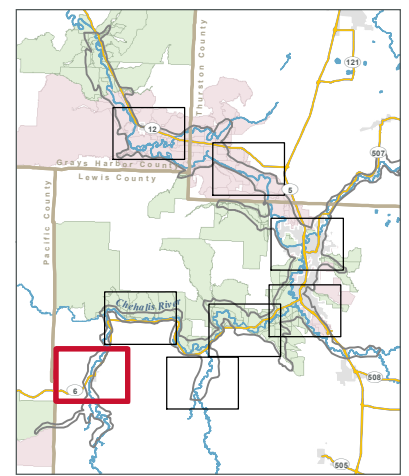
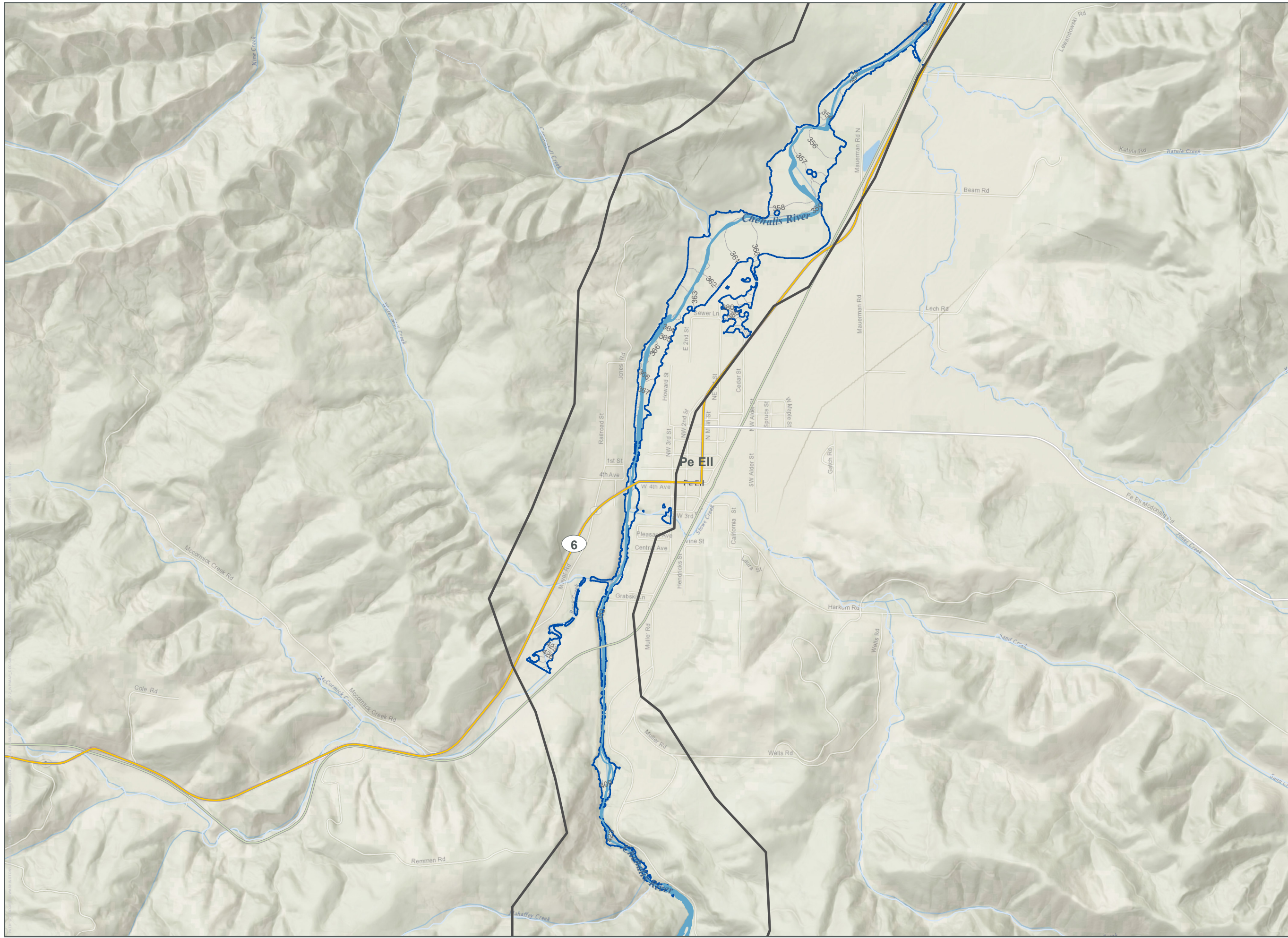
- Library
- Schools & Day Care
- Place of worship
- Fire Stations
- Police Station
- Streams
- Roads
- State Trail
- State Park Boundary
- County Boundary
- Study Area
- 1ft Contour WSEL

**Proposed Action Catastrophic
Flood Late Century (WSEL)**

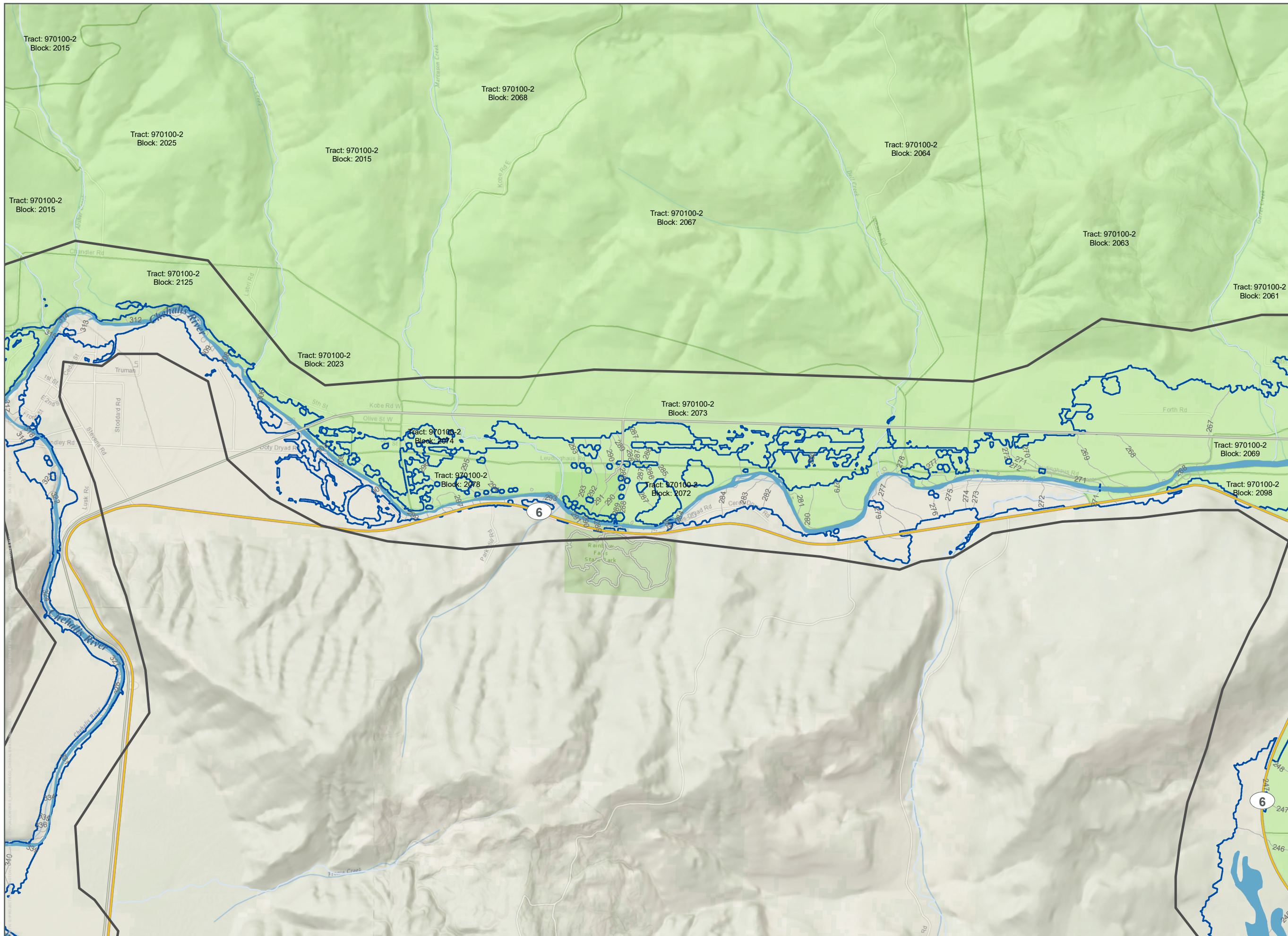











**FIGURE 21
RESIDENTIAL COMMUNITY
FLOODING – NO
ACTION ALTERNATIVE**

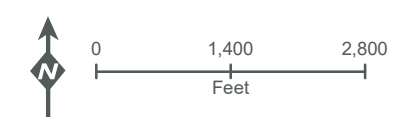
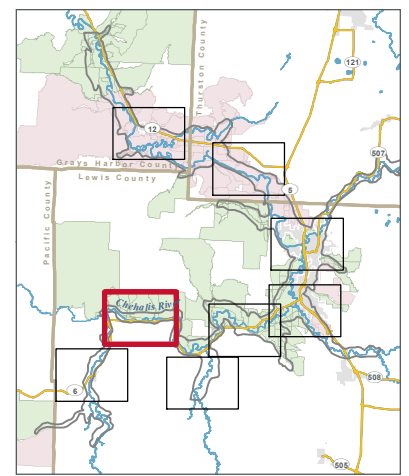
-  Streams
-  Roads
-  State Trail
-  County Boundary
-  Study Area
- EJ Population
 -  No
 -  Yes
-  1ft Contour WSEL
-  No Action Catastrophic Flood Late Century (WSEL)












**FIGURE 22
RESIDENTIAL COMMUNITY
FLOODING – NO
ACTION ALTERNATIVE**

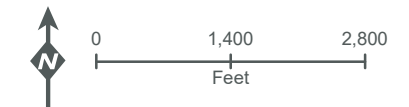
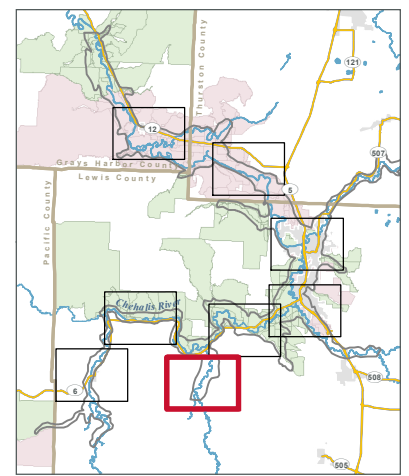
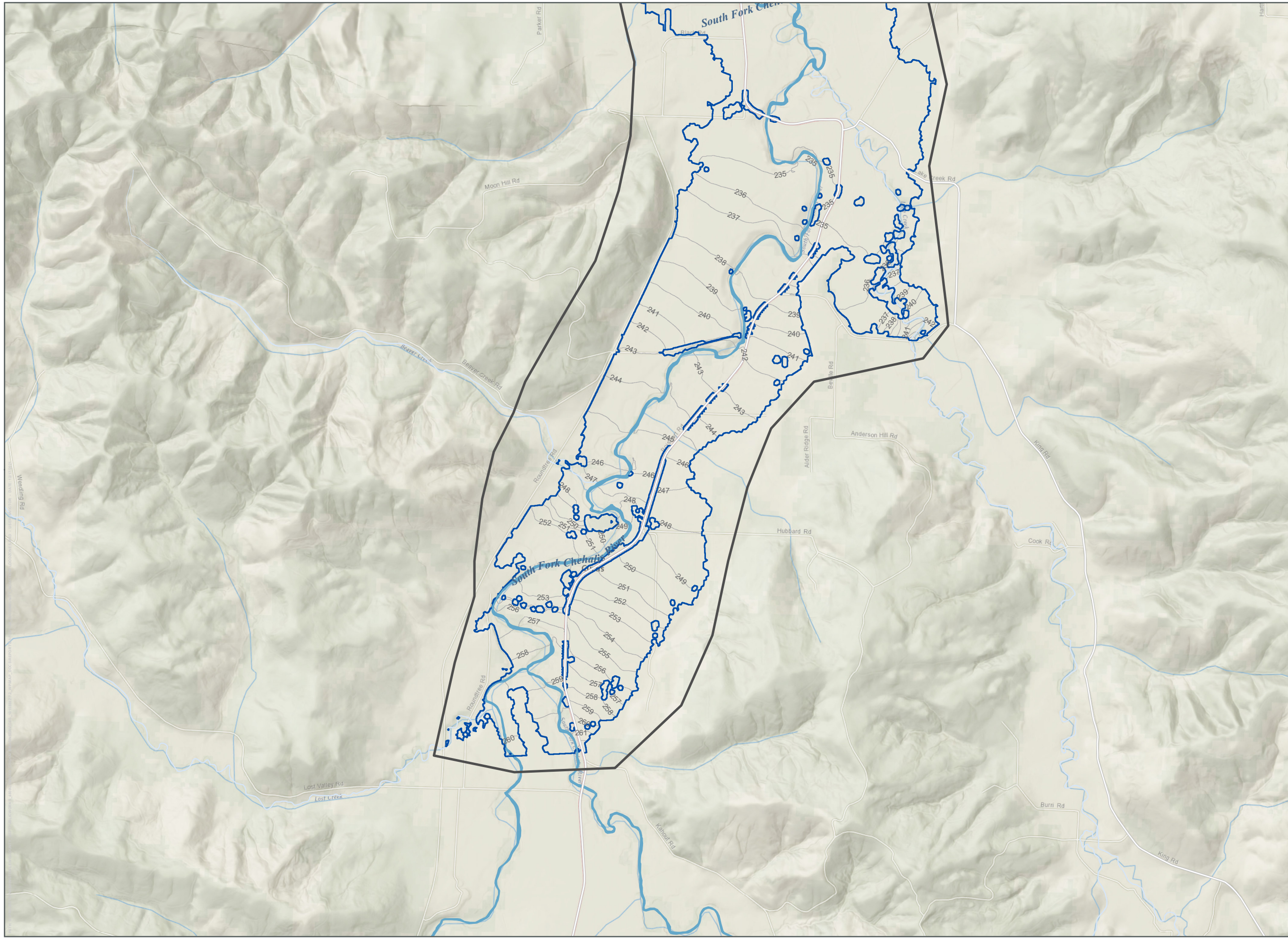


-  Streams
-  Roads
-  State Trail
-  County Boundary
-  Study Area
- EJ Population**
-  No
-  Yes
-  1ft Contour WSEL
-  No Action Catastrophic Flood Late Century (WSEL)

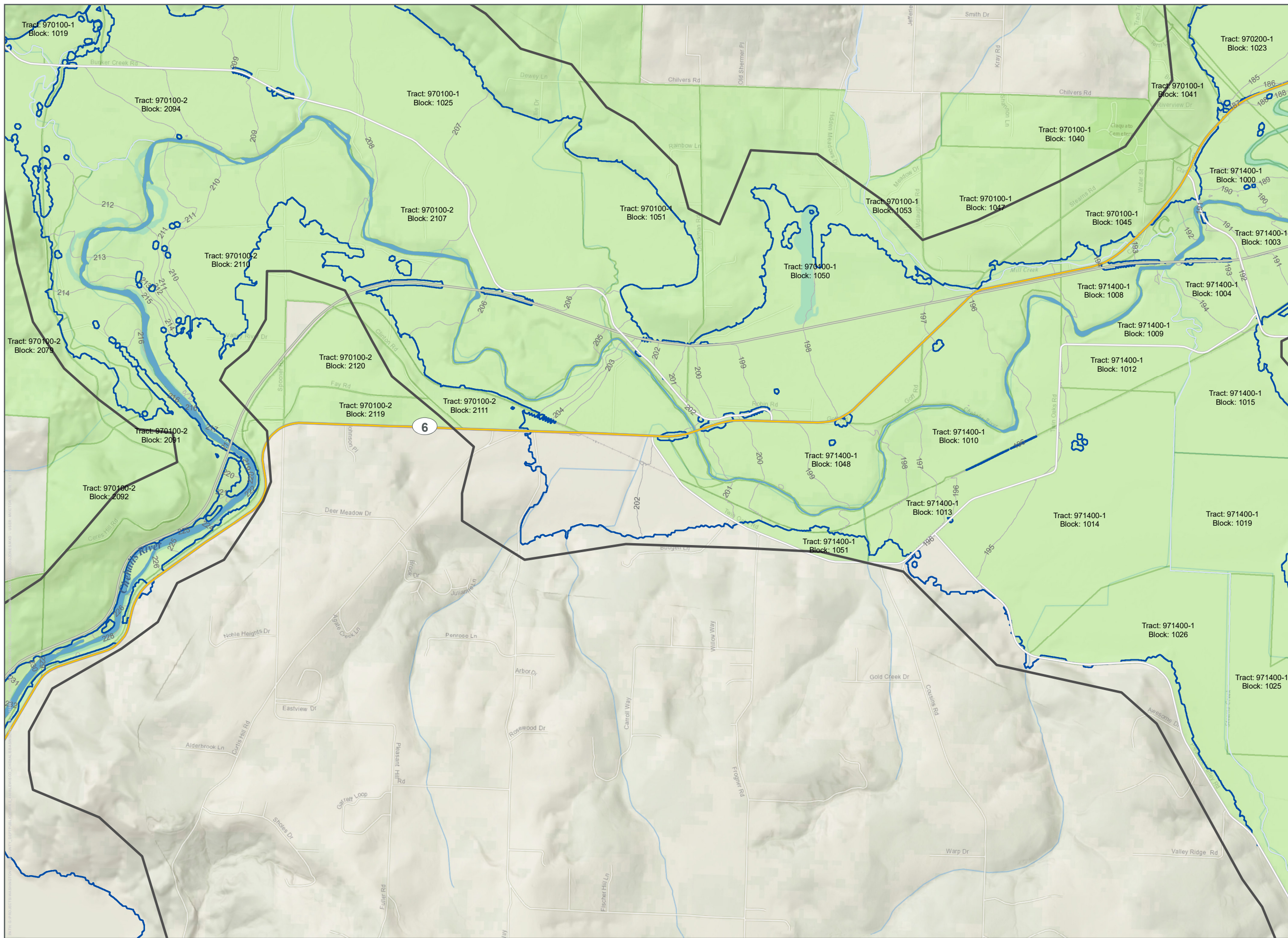











**FIGURE 23
RESIDENTIAL COMMUNITY
FLOODING – NO
ACTION ALTERNATIVE**

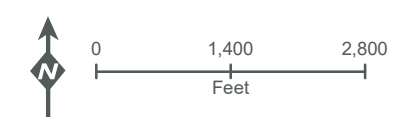
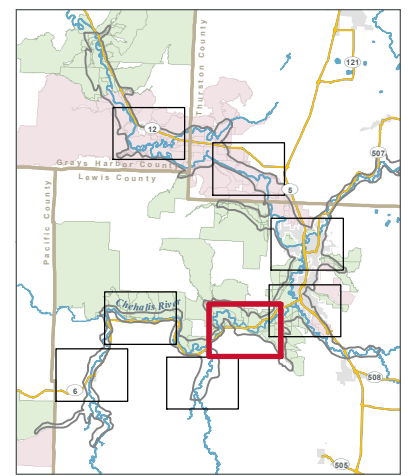
-  Streams
-  Roads
-  State Trail
-  County Boundary
-  Study Area
- EJ Population**
-  No
-  Yes
-  1ft Contour WSEL
-  No Action Catastrophic Flood Late Century (WSEL)



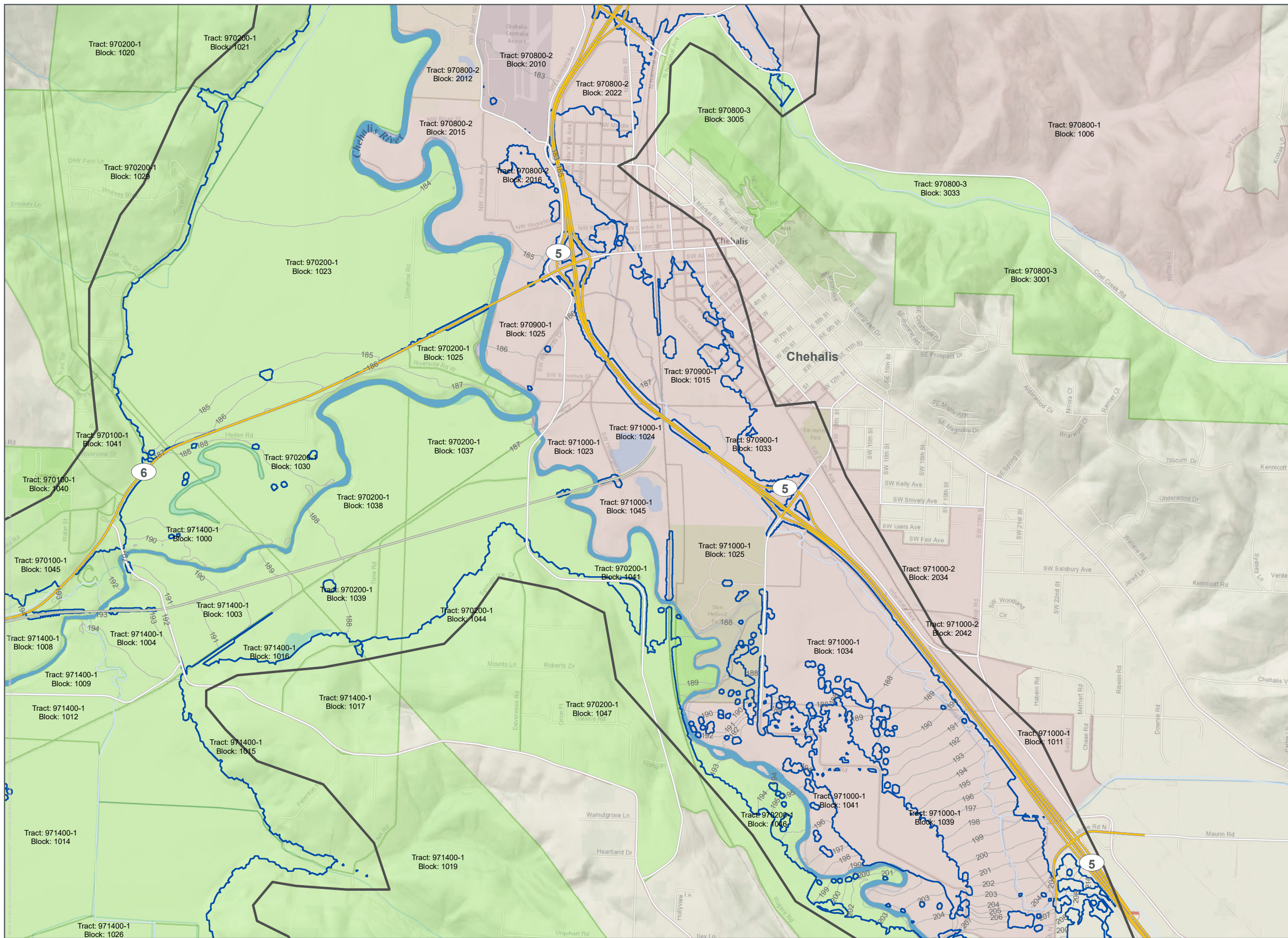
**FIGURE 24
RESIDENTIAL COMMUNITY
FLOODING – NO
ACTION ALTERNATIVE**



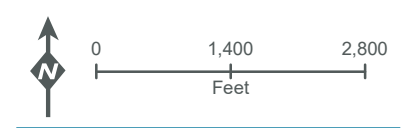
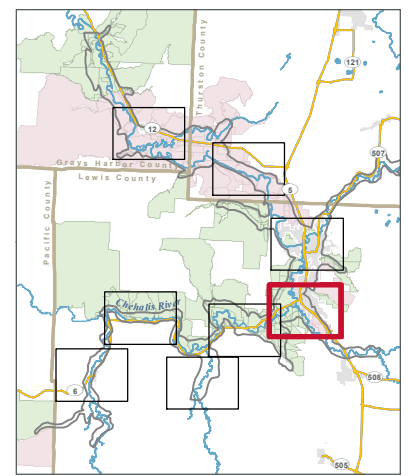
-  Streams
-  Roads
-  State Trail
-  County Boundary
-  Study Area
- EJ Population**
-  No
-  Yes
-  1ft Contour WSEL
-  No Action Catastrophic Flood Late Century (WSEL)



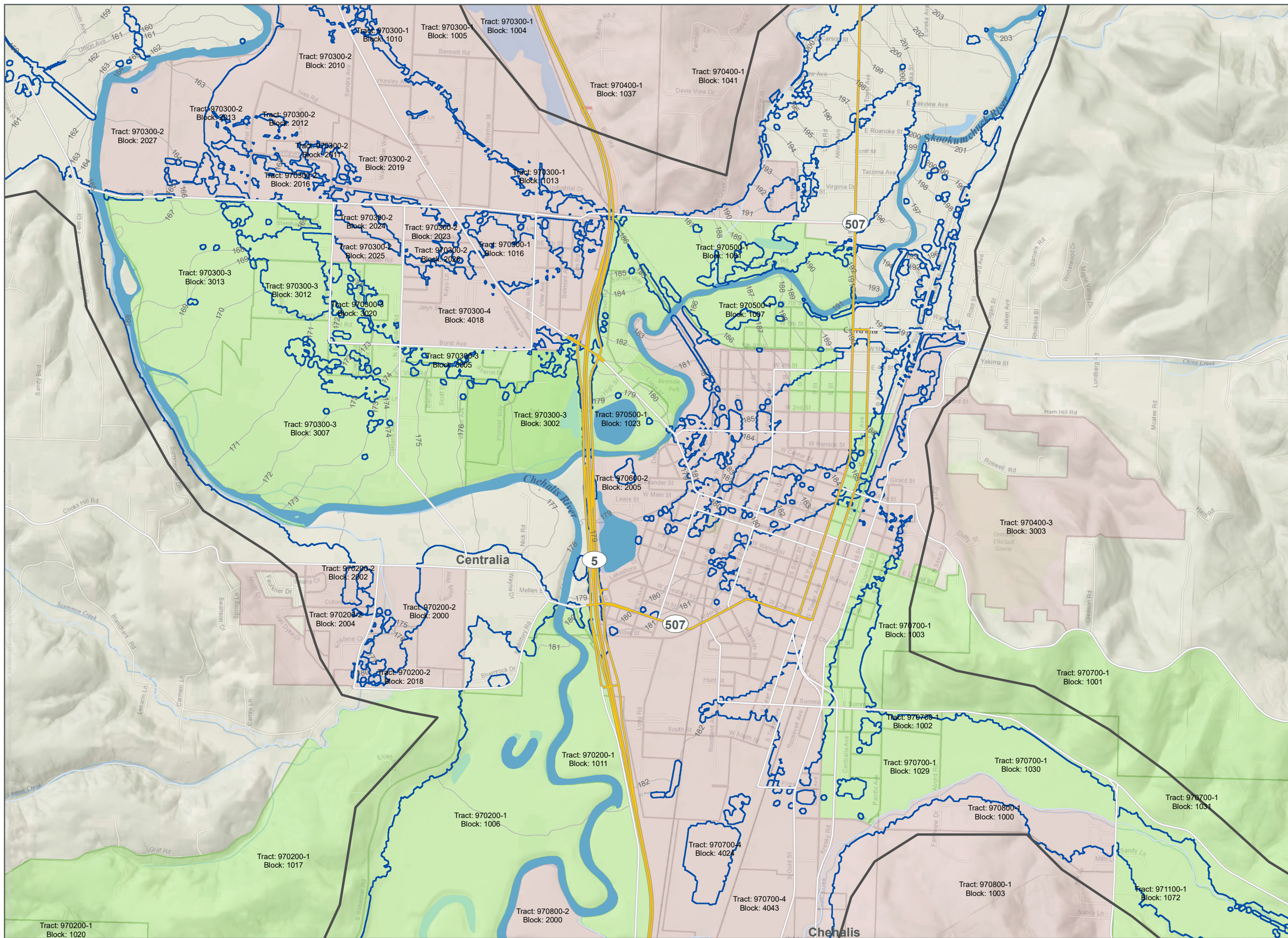
**FIGURE 25
RESIDENTIAL COMMUNITY
FLOODING – NO
ACTION ALTERNATIVE**



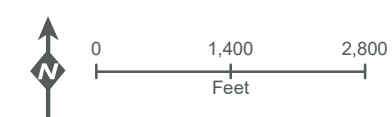
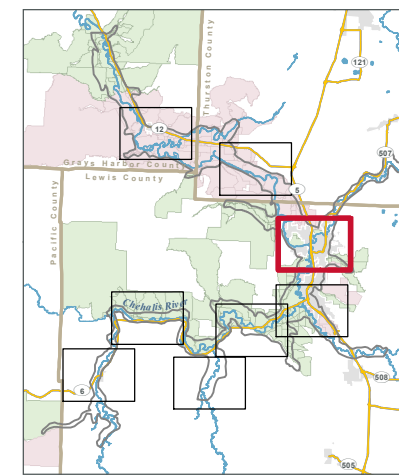
- Streams
- Roads
- State Trail
- County Boundary
- Study Area
- EJ Population**
- No
- Yes
- 1ft Contour WSEL
- No Action Catastrophic Flood Late Century (WSEL)



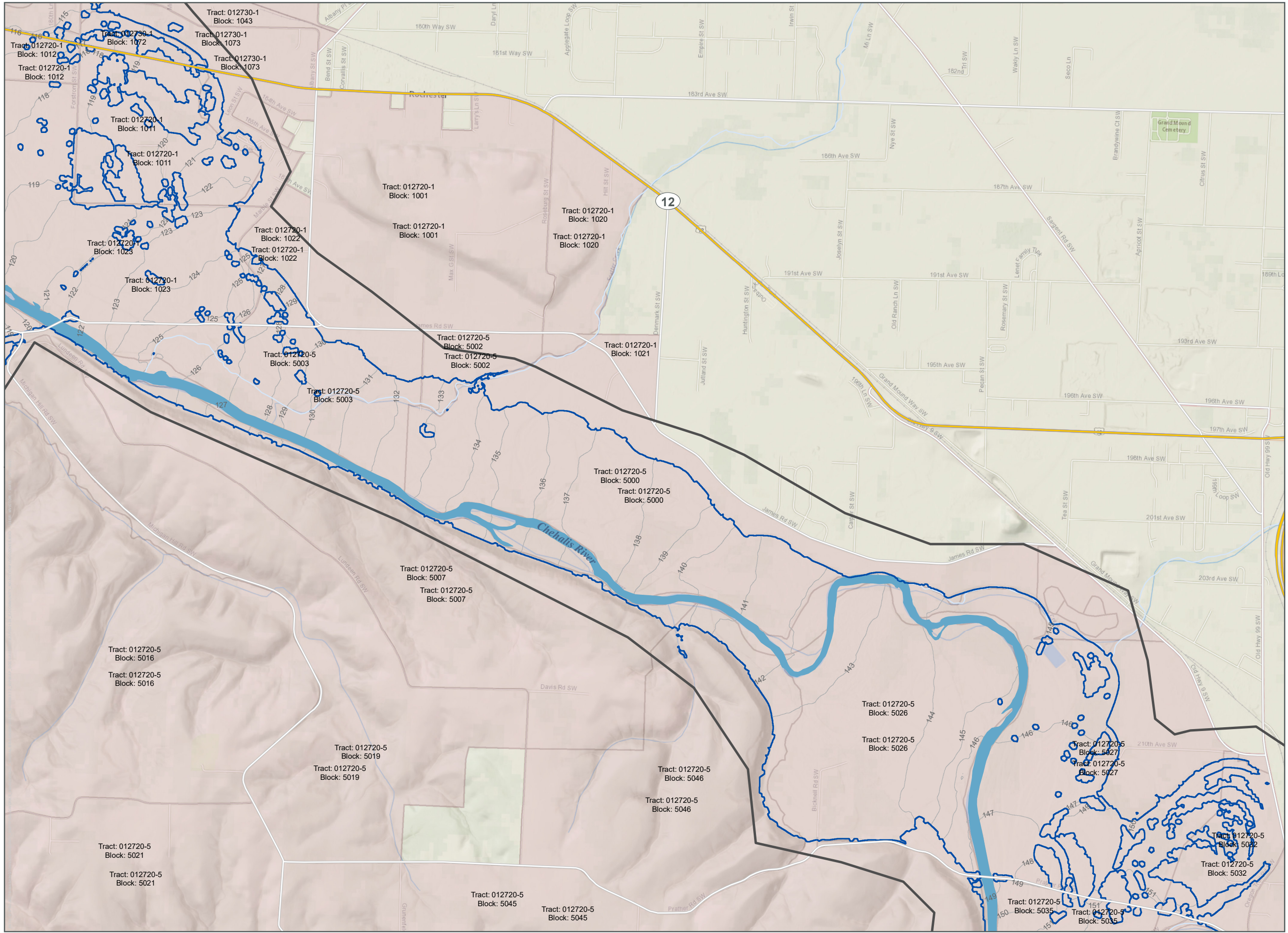
**FIGURE 26
RESIDENTIAL COMMUNITY
FLOODING – NO
ACTION ALTERNATIVE**



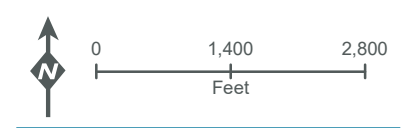
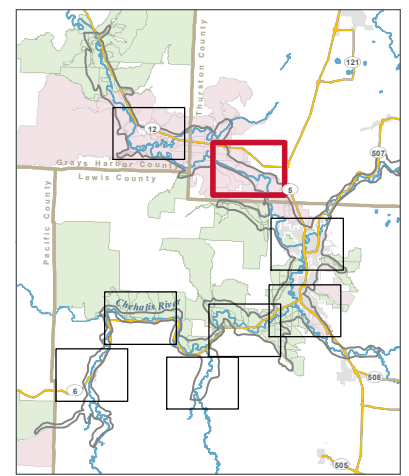
- Streams
- Roads
- State Trail
- County Boundary
- Study Area
- EJ Population
 - No
 - Yes
- 1ft Contour WSEL
- No Action Catastrophic Flood Late Century (WSEL)



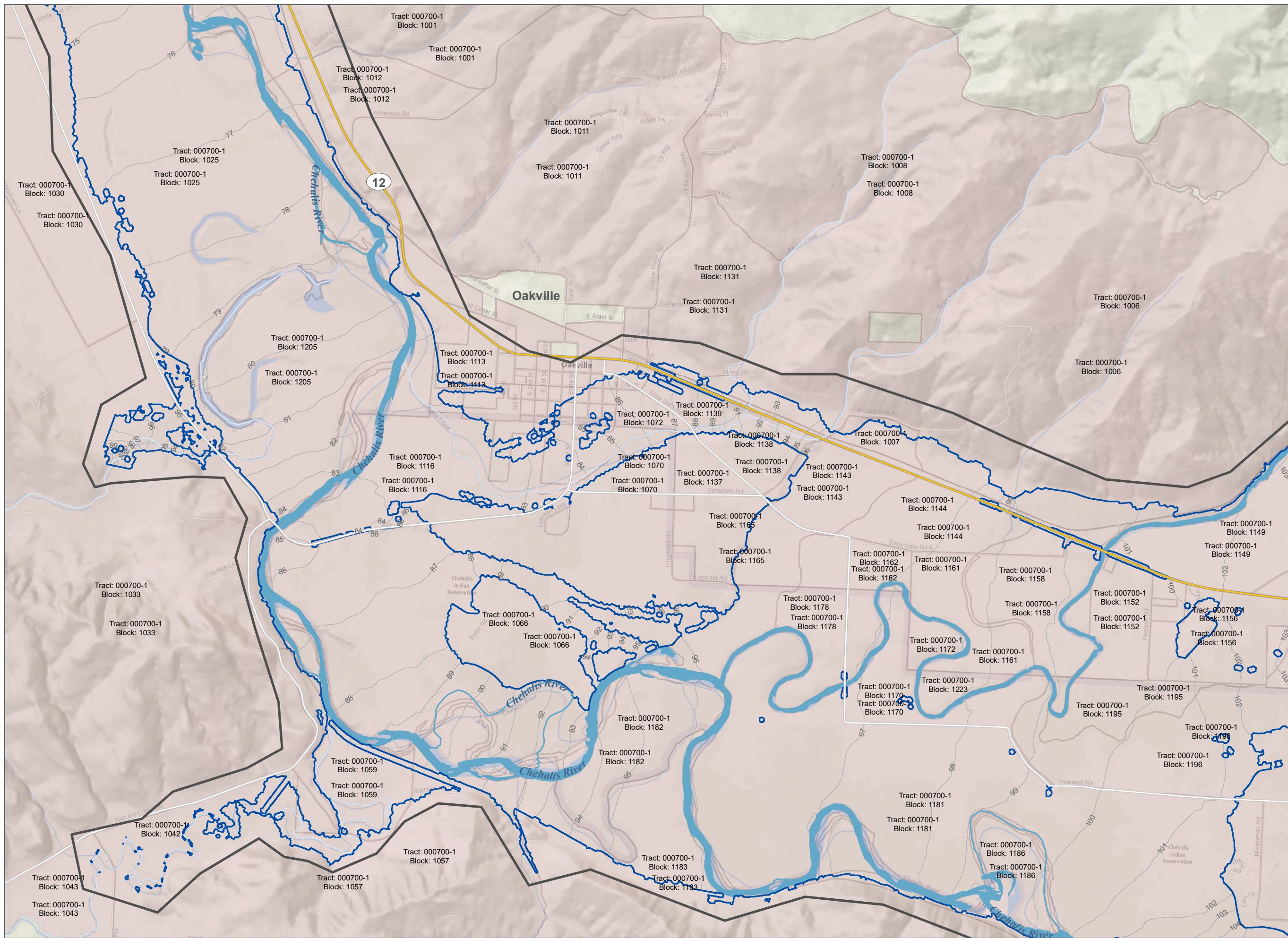
**FIGURE 27
RESIDENTIAL COMMUNITY
FLOODING – NO
ACTION ALTERNATIVE**



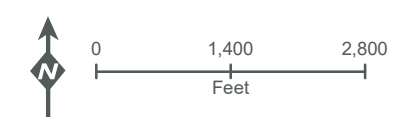
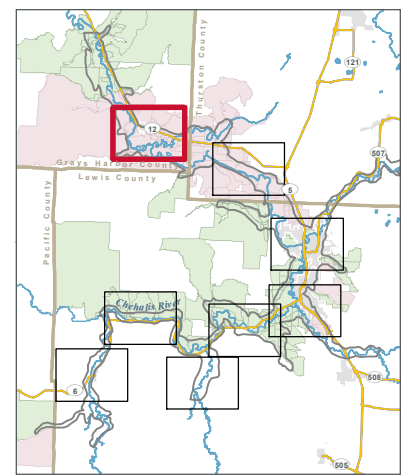
- Streams
- Roads
- State Trail
- County Boundary
- Study Area
- EJ Population
 - No
 - Yes
- 1ft Contour WSEL
- No Action Catastrophic Flood Late Century (WSEL)













**FIGURE 28
RESIDENTIAL COMMUNITY
FLOODING – NO
ACTION ALTERNATIVE**

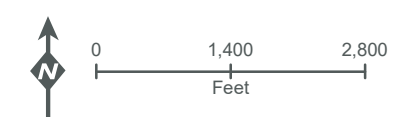
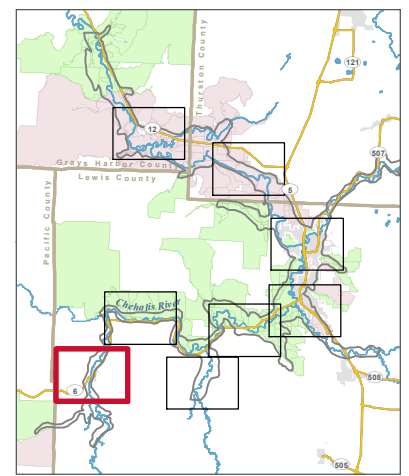
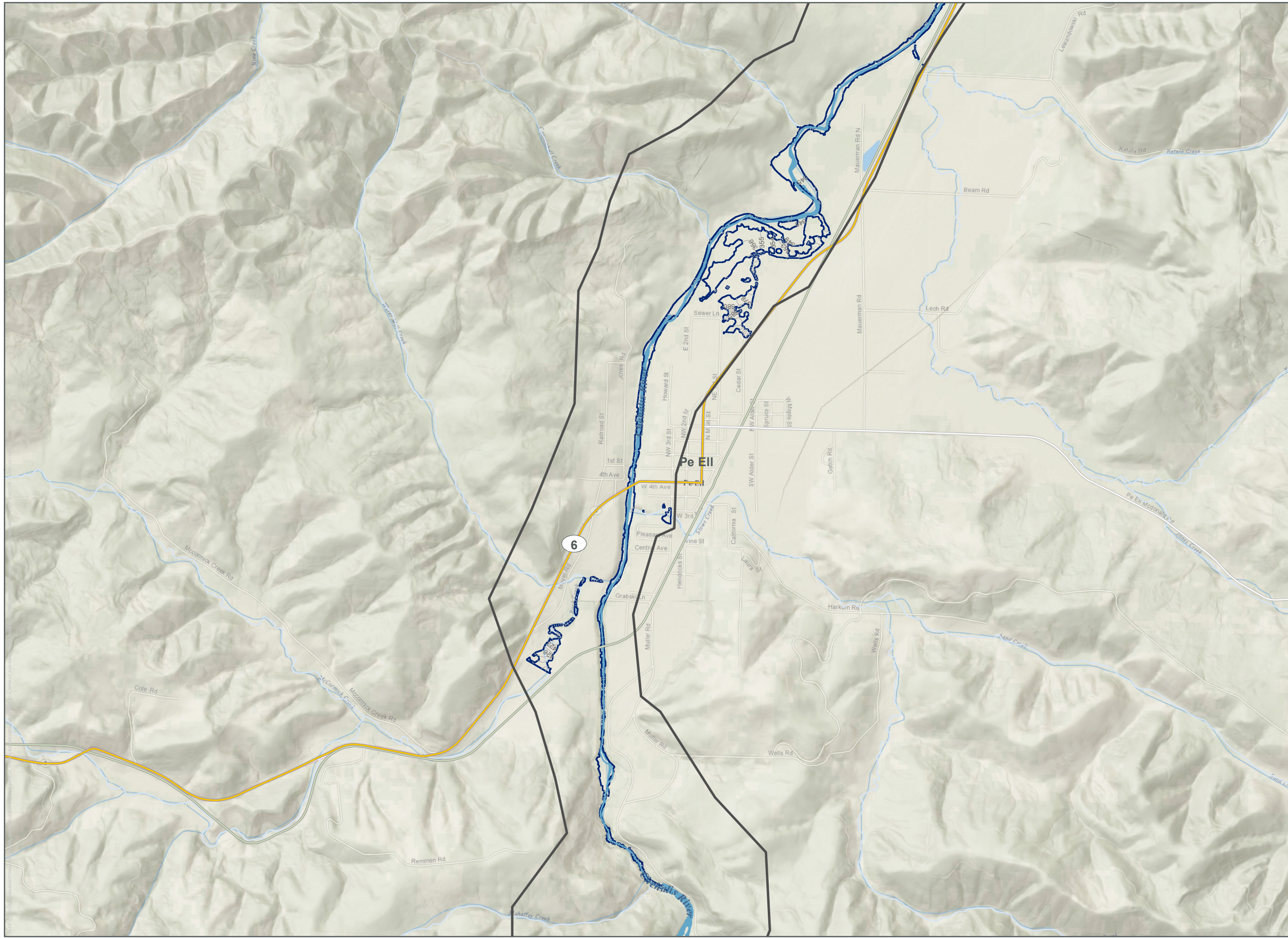


- Streams
- Roads
- State Trail
- County Boundary
- Study Area
- EJ Population
 - No
 - Yes
- 1ft Contour WSEL
- No Action Catastrophic Flood Late Century (WSEL)

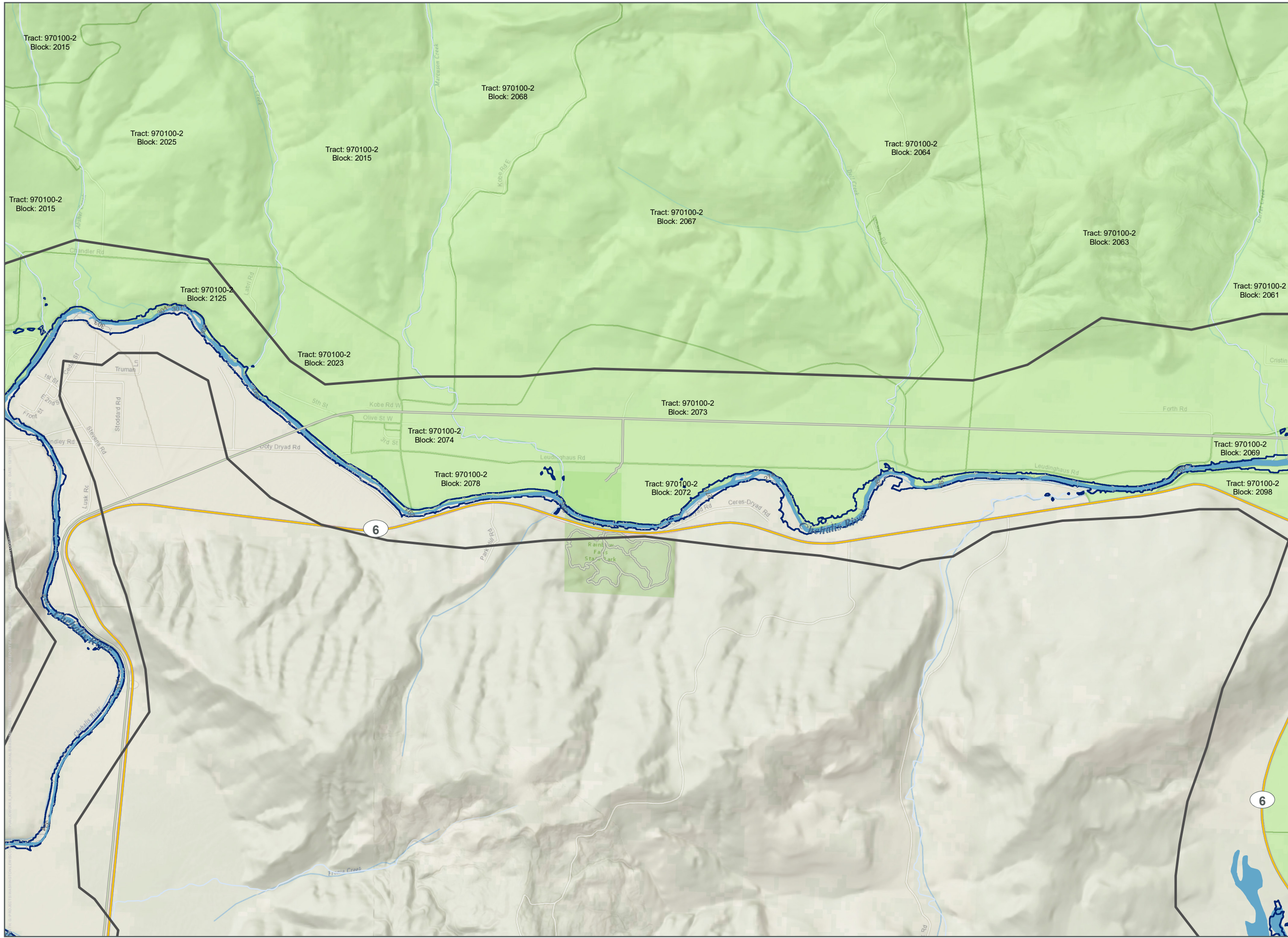


**FIGURE 29
RESIDENTIAL COMMUNITY
FLOODING –
PROPOSED ACTION**

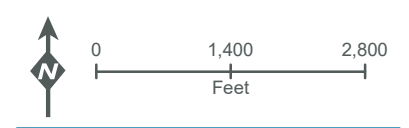
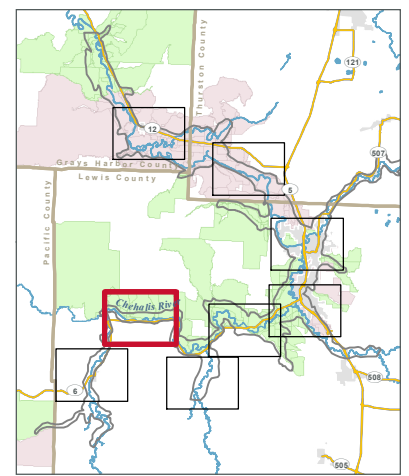
-  Streams
-  Roads
-  State Trail
-  County Boundary
-  Study Area
- EJ Population**
-  No
-  Yes
-  1ft Contour WSEL
-  Proposed Action
-  Catastrophic Flood Late Century (WSEL)













**FIGURE 30
RESIDENTIAL COMMUNITY
FLOODING –
PROPOSED ACTION**

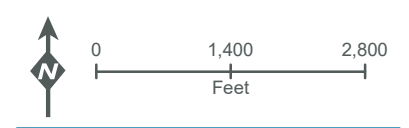
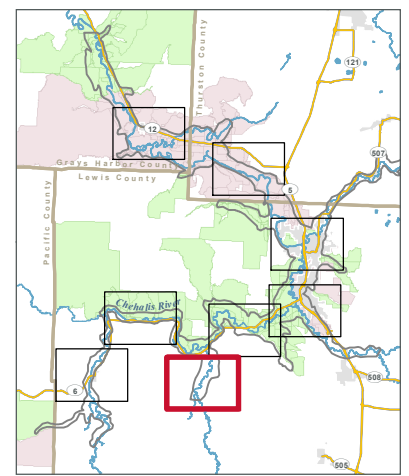
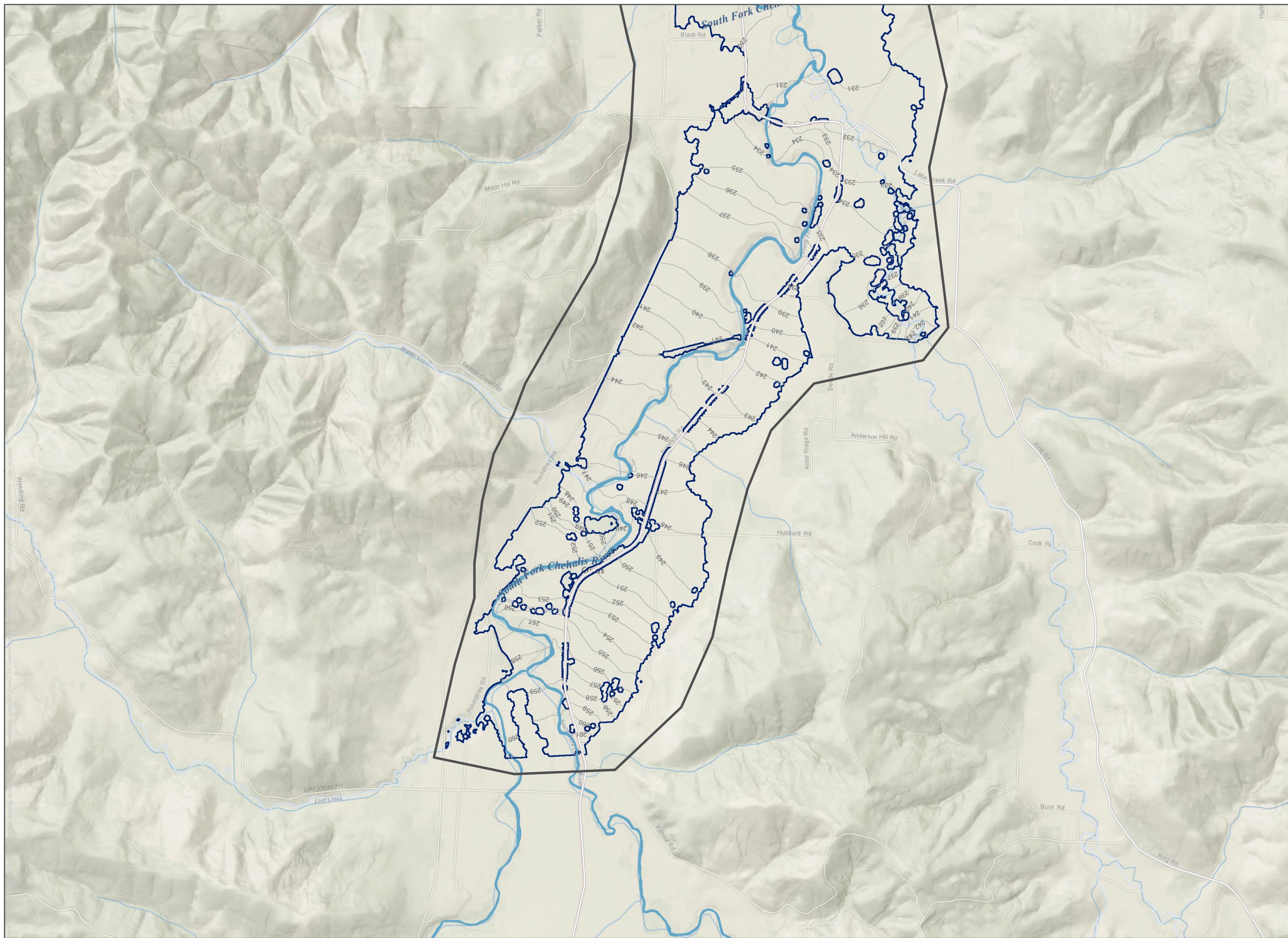


- Streams
- Roads
- State Trail
- County Boundary
- Study Area
- EJ Population**
- No
- Yes
- 1ft Contour WSEL
- Proposed Action
Catastrophic Flood Late Century (WSEL)

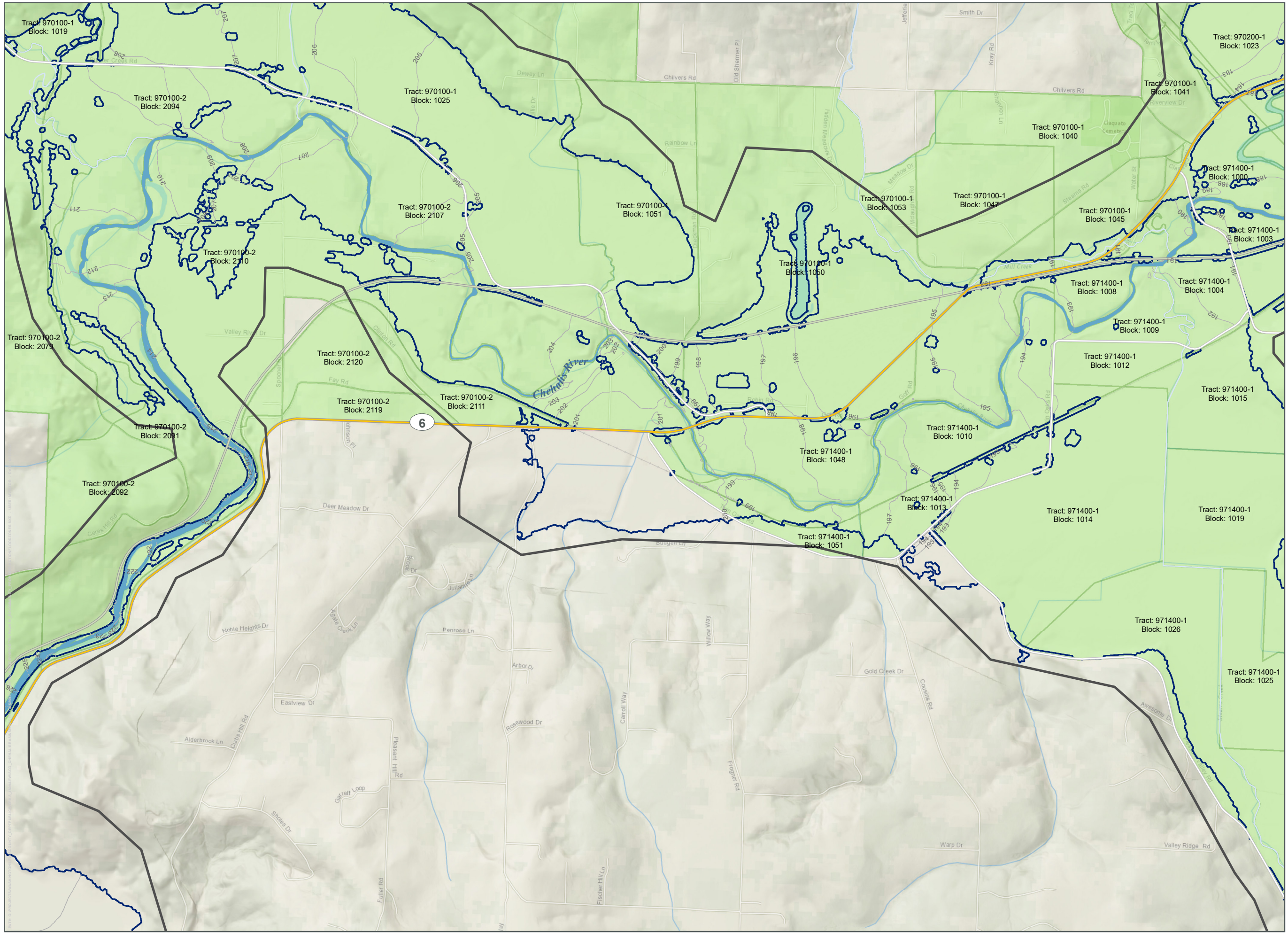


**FIGURE 31
RESIDENTIAL COMMUNITY
FLOODING –
PROPOSED ACTION**

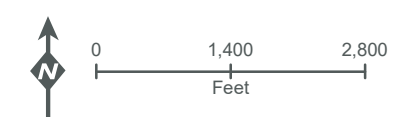
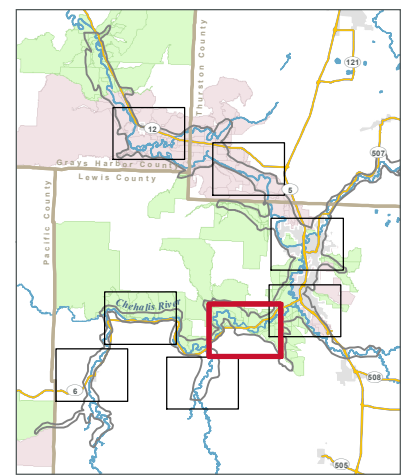
-  Streams
-  Roads
-  State Trail
-  County Boundary
-  Study Area
- EJ Population**
-  No
-  Yes
-  1ft Contour WSEL
-  Proposed Action
-  Catastrophic Flood Late Century (WSEL)



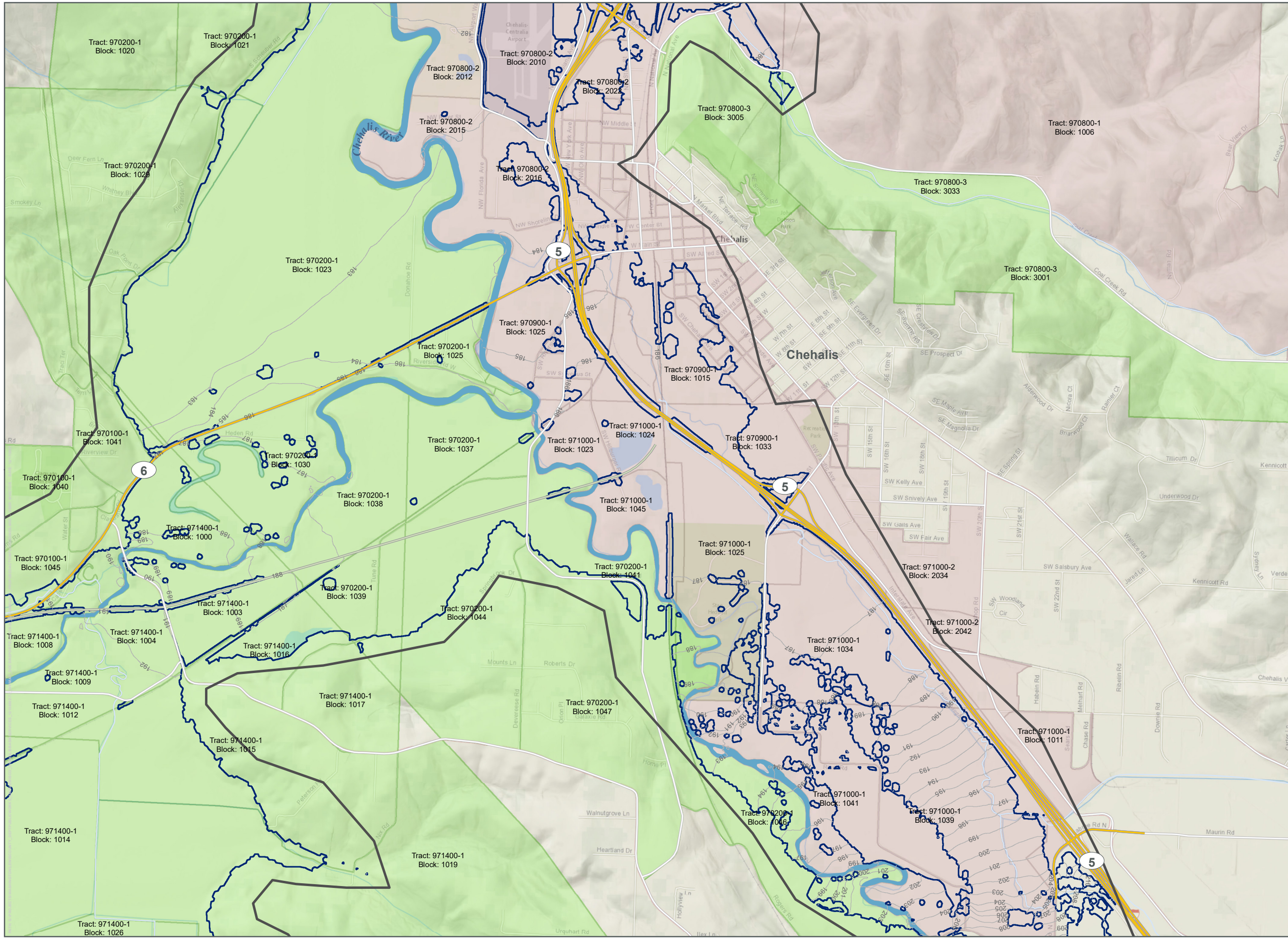
**FIGURE 32
RESIDENTIAL COMMUNITY
FLOODING –
PROPOSED ACTION**



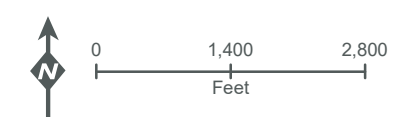
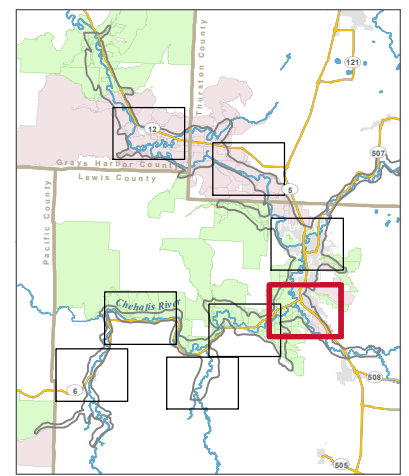
- Streams
- Roads
- State Trail
- County Boundary
- Study Area
- EJ Population**
- No
- Yes
- 1ft Contour WSEL
- Proposed Action
- Catastrophic Flood Late Century (WSEL)



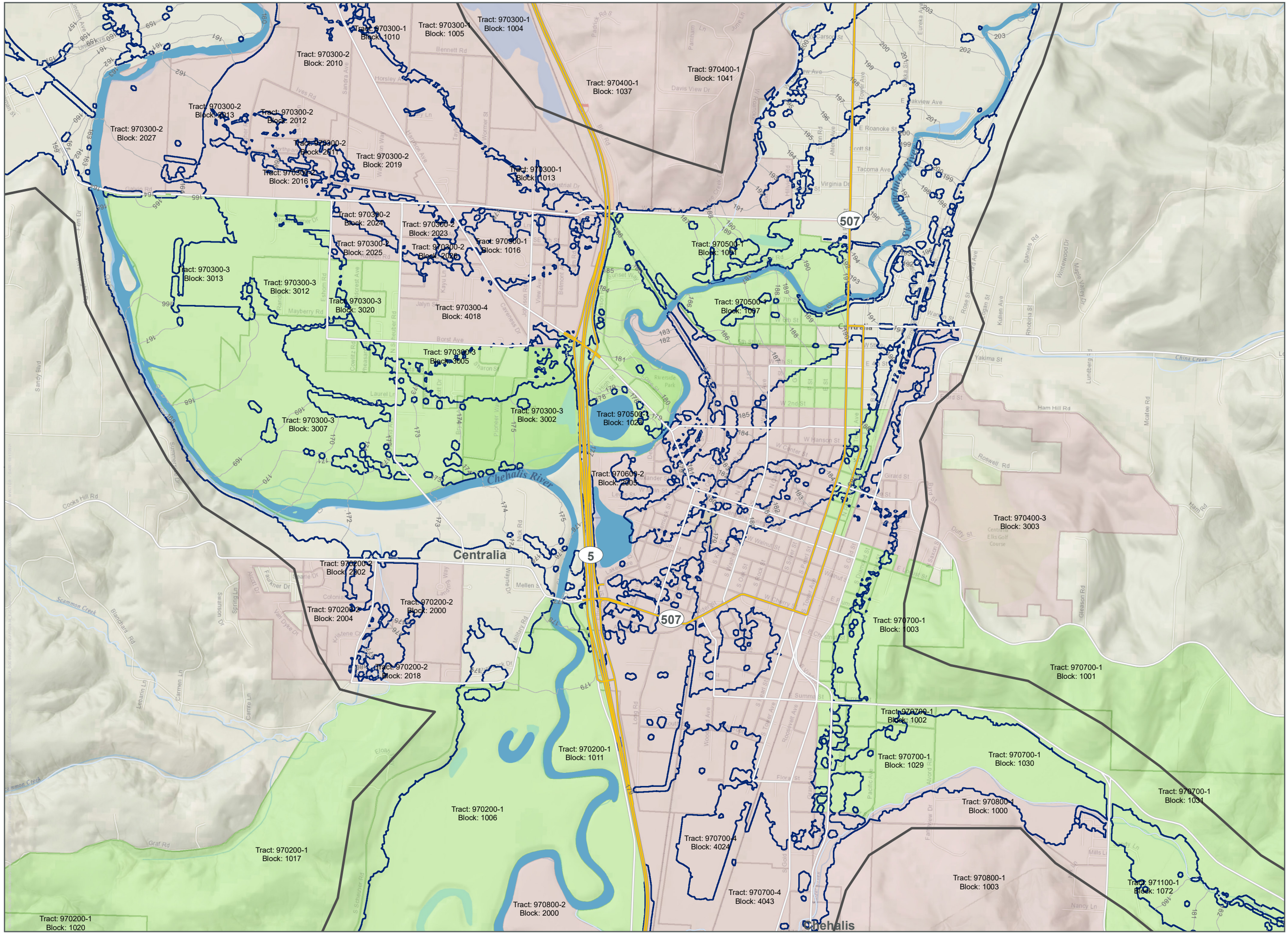
**FIGURE 33
RESIDENTIAL COMMUNITY
FLOODING –
PROPOSED ACTION**



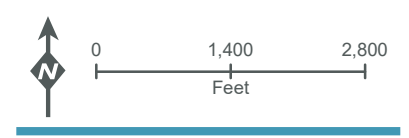
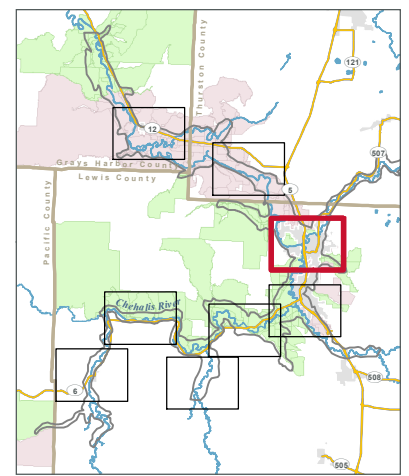
- Streams
- Roads
- State Trail
- County Boundary
- Study Area
- EJ Population**
- No
- Yes
- 1ft Contour WSEL
- Proposed Action
Catastrophic Flood Late
Century (WSEL)



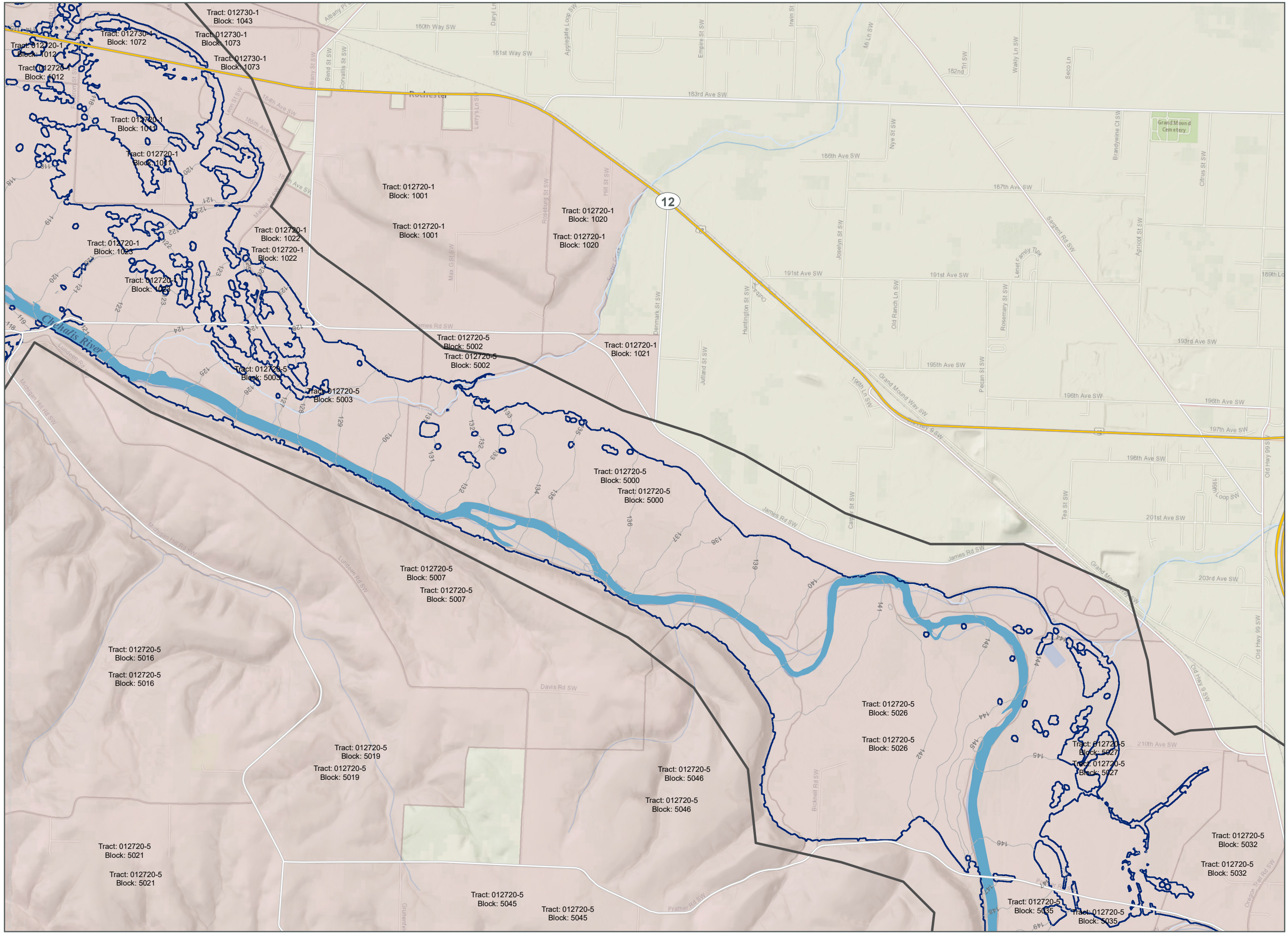
**FIGURE 34
RESIDENTIAL COMMUNITY
FLOODING –
PROPOSED ACTION**



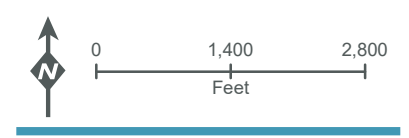
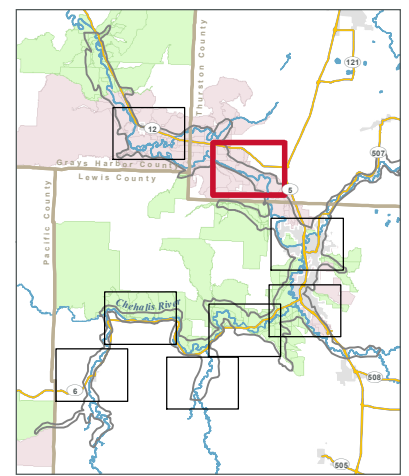
- Streams
- Roads
- State Trail
- County Boundary
- Study Area
- EJ Population**
- No
- Yes
- 1ft Contour WSEL
- Proposed Action Catastrophic Flood Late Century (WSEL)



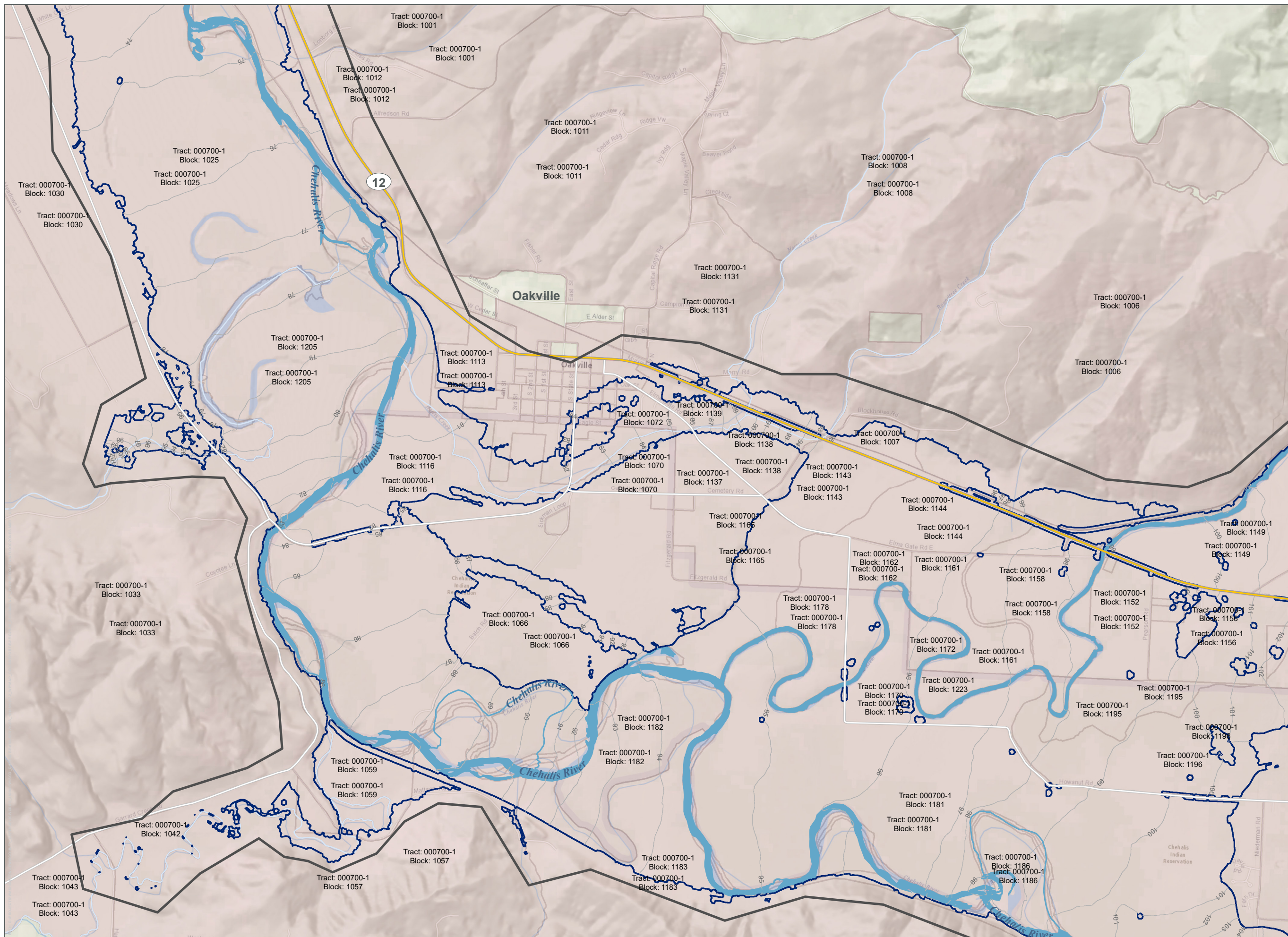
**FIGURE 35
RESIDENTIAL COMMUNITY
FLOODING –
PROPOSED ACTION**



- Streams
- Roads
- State Trail
- County Boundary
- Study Area
- EJ Population**
- No
- Yes
- 1ft Contour WSEL
- Proposed Action
- Catastrophic Flood Late Century (WSEL)



**FIGURE 36
RESIDENTIAL COMMUNITY
FLOODING –
PROPOSED ACTION**



- Streams
- Roads
- State Trail
- County Boundary
- Study Area
- EJ Population
- No
- Yes
- 1ft Contour WSEL
- 🌀 Proposed Action
Catastrophic Flood Late
Century (WSEL)

