Appendix L: Aesthetics and Visual Quality Technical Appendix

For Programmatic Environmental Impact Statement on Green Hydrogen Energy Facilities in Washington State

By

HDR

For the

Shorelands and Environmental Assistance Program

Washington State Department of Ecology

Olympia, Washington

January 2025

DEPARTMENT OF ECOLOGY State of Washington

Table of Contents

List of Figures and Tables

Figures

Tables

Acronyms and Abbreviations List

BESS	battery energy storage system
FAA	Federal Aviation Administration
I-	Interstate
KOP	key observation point
PEIS	Programmatic Environmental Impact Statement
SEPA	State Environmental Policy Act
SMR	steam-methane reforming
SR	State Route
US	U.S. Highway

Summary

This technical appendix describes the aesthetics and visual quality conditions in the study area. It also describes the regulatory context, potential impacts, and actions that could avoid or reduce impacts.

This technical appendix analyzes the following key features:

- Long-term change or reduction in visual quality
- Creation of a new source of light or glare that would adversely affect day or nighttime views in the area

Findings for aesthetics and visual quality impacts described in this technical appendix are summarized as follows:

- Through compliance with laws and permits, and with implementation of actions that could avoid and reduce impacts, construction, operations, and decommissioning activities would likely result in **less than significant impacts** related to aesthetics and visual quality.
- Through compliance with laws and permits, and with implementation of actions to avoid and mitigate significant impacts, green hydrogen facilities would have **no significant and unavoidable adverse impacts** on aesthetics or visual quality from construction, operation, or decommissioning.

1 Introduction

This technical appendix describes aesthetics and visual quality within the study area and assesses probable impacts associated with the types of green hydrogen facilities evaluated, and a No Action Alternative. Chapter 2 of the State Environmental Policy Act (SEPA) Programmatic Environmental Impact Statement (PEIS) provides a description of the types of facilities evaluated.

This section provides an overview of the aspects of aesthetics and visual quality evaluated and lists relevant regulations that contribute to the evaluation of potential impacts.

1.1 Resource description

Visual resources refer to all objects (built and natural, moving and stationary) and features (e.g., landforms and waterbodies) that are visible on a landscape. These resources add to or detract from the aesthetic or scenic quality (or visual appeal) of the landscape. A visual impact is the creation of an intrusion or perceptible contrast that affects the scenic quality of a landscape. A visual impact can be perceived by an individual or group as either positive or negative, depending on a variety of factors or conditions (e.g., personal experience, time of day, and weather/season).

Visual resources considered in this analysis include the following:

- Designated scenic vistas
- Designated scenic corridors, including roadways, trails, rivers, and streams (including federally designated Wild and Scenic Rivers)
- Designated viewsheds, ridgelines, other elevated (i.e., visually prominent) natural features
- Areas with comprehensive plan, zoning, or other land controls that define an area as scenic or designated/protected rural character
- Publicly accessible vantage points having moderate to high visual or rural character and quality, that are well traveled and populated
- Recreational resources
- Areas sensitive to light and/or glare, including designated night sky areas, as well as areas potentially affecting military and commercial aircraft

In the study area, the following resources could have impacts that overlap with impacts to aesthetics and visual quality. Impacts on these resources are reported in their respective technical appendices:

- **Tribal rights, interests, and resources; and historic and cultural resources:** Tribal and cultural resources may be affected by visual changes in some areas, and sensitive viewers could include members of local Tribes. Information regarding potential visual changes inform the Tribal and cultural resources impact analyses in the *Tribal Rights,* *Interests, and Resources Technical Appendix* and the *Historic and Cultural Resources Technical Appendix.*

- **Recreation:** Recreation impacts are informed by the analysis of visual effects on the recreational experience. Recreational resources impacts are presented in the *Recreation Technical Appendix.*
- **Biological resources:** Potential effects of light and glare on terrestrial and aquatic species and habitats are analyzed in the *Biological Resources Technical Appendix.*
- **Land use:** Potential effects to rural character are analyzed in the *Land Use Technical Appendix*.

1.2 Regulatory context

Table 1 provides an inventory of applicable laws, regulations, policies, and plans that contribute to the evaluation of aesthetics and visual quality. For local regulations and plans, it would be dependent on the location of a facility. The developer would consult with the appropriate county or other local officials to determine local regulatory guidance that would be applied to project-level SEPA reviews.

Table 1. Applicable laws, plans, and policies

Regulation	Description
Federal	
U.S. Department of Transportation Federal Highway Administration National Scenic Byways and All-American Roads Program	This program designates National Scenic Roads that meet the criteria for at least one of six "intrinsic qualities": archeological, cultural, historic, natural, recreational, and scenic. The features contributing to the distinctive characteristics of the corridor's intrinsic quality are recognized throughout the region and are considered regionally significant. Designated All-American Roads meet two of these "intrinsic qualities."
U.S. National Wild and Scenic Rivers System (Wild and Scenic Rivers Act of 1968)	This program protects certain rivers that have "outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural or other similar values."
Federal Aviation Administration (FAA) Advisory Circular 70/7460-1M, Obstruction Marking and Lighting	The advisory circular describes FAA's standards for marking and lighting structures to promote aviation safety.
State	
Chapter 47.39 Revised Code of Washington, Scenic and Recreational Highway Act of 1967	This legislation establishes the State's Scenic Byway program and standards for eligibility and maintenance of scenic roadways and corridors.
Local	
City and county comprehensive plans, zoning ordinances, and codes, including night sky ordinances	Many counties and cities in Washington have codes, plans, and ordinances that are relevant to an understanding of visual quality and potential impacts of facilities.

2 Methodology

This section provides an overview of the process for evaluating potential impacts and the criteria for determining the occurrence and degree of impact.

2.1 Study area

The study area for aesthetics and visual quality includes the PEIS geographic scope of study for green hydrogen facilities (Figure 1), the surrounding viewsheds and scenic resources.

The study area for the evaluation of aesthetic and visual resources associated with the construction and operation of green hydrogen facilities would be determined by the presence (or absence) of aesthetic and visual resources during project-specific reviews. Parameters could include sensitive visual resources such as visually sensitive vantage points, designated scenic resources (as listed previously), and receptors and facilities sensitive to light/glare (such as airports or residential neighborhoods).

Figure 1, which shows the PEIS geographic scope of study, does not include federal lands, national parks, wilderness areas, wildlife refuges, state parks, or Tribal reservation lands, but information related to these areas is provided as context for the affected environment.

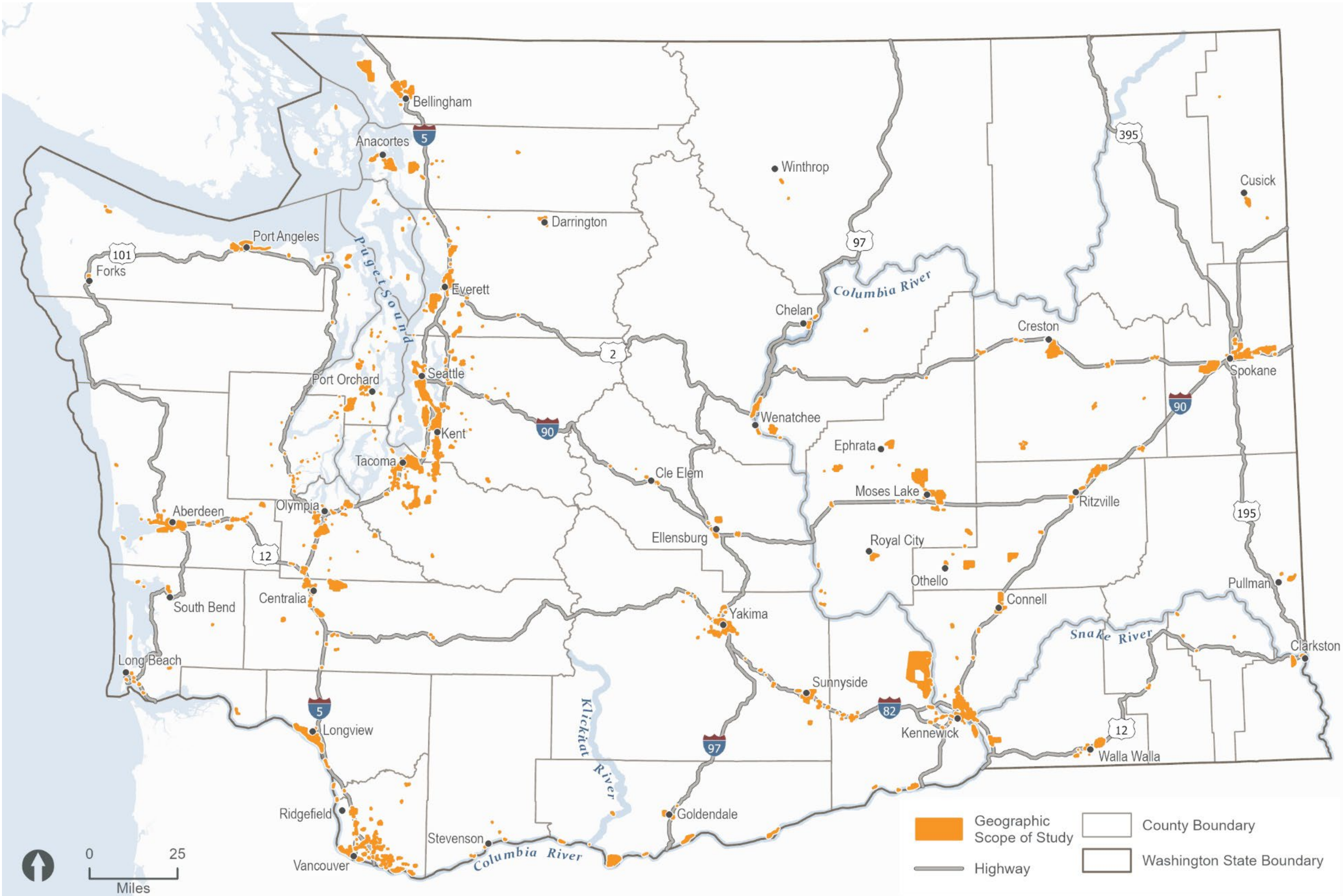

Figure 1. Green Hydrogen Energy Facilities PEIS geographic scope of study

2.2 Technical approach

The general technical approach for the qualitative assessment of aesthetic and visual quality impacts in the study area included the following:

- Existing visual or rural character, land uses that may be sensitive to strong visual contrast (including light and glare), and sensitive viewer groups
- Potential impacts of facilities on existing visual or rural character and sensitive viewer groups or land uses
- Effects of lighting and glare on sensitive receptors

The PEIS analyzes a timeframe of up to 25 years of potential facility construction and up to 50 years of potential facility operations (totaling up to 75 years into the future).

2.3 Impact assessment approach

The magnitude of the aesthetics and visual quality impacts associated with a green hydrogen facility would depend on site- and project-specific factors, including the following:

- Distance of the facility from publicly accessible vantage points and their placement within the context of foreground, middleground, and background views[1]
- Size of the facility and size and height of facility components
- Surface treatment and color of buildings and other structures
- The presence and arrangement of lights in the facility and on other structures
- The presence of workers and vehicles
- Viewer characteristics, such as the number and type of viewers (e.g., landowners in the vicinity, residents, tourists, recreationists, motorists, and workers) and their attitudes toward green hydrogen or industrial facilities
- The visual quality and sensitivity of the landscape, including the presence of sensitive visual, Tribal, and cultural resources, including historic properties
- The existing level of development and activities in the area and nearby areas, and the landscape's capacity to withstand human alteration without loss of landscape character (i.e., scenic integrity and visual absorption capability)
- Weather and lighting conditions

These factors would be evaluated in detail during future site-specific environmental analysis. A general discussion of impacts is provided in this technical appendix.

[1] The foreground, middleground, and background refer to areas in space. The foreground refers to the nearest area. The background refers to the area of space in the distance. The middleground occupies the space in between.

For the purposes of this assessment, potentially significant impacts would occur if a facility resulted in the following:

- Long-term changes in visual quality that would significantly contrast with the existing visual character, or with designated scenic resources, including:
  - Permanent clearing of vegetation
  - Construction of a large structure in a previously undeveloped area
  - Construction of a structure that would block views or future views
- Creation of a new source of light or glare that would adversely affect views in the area continuously or near-continuously and be visible to a substantial number of people

3 Technical Analysis and Results

3.1 Overview

This section provides an analysis of potential impacts on aesthetics and visual quality that might occur for green hydrogen facilities analyzed in the PEIS. This section also evaluates actions that could avoid, minimize, or reduce the identified impacts and potential unavoidable significant adverse impacts.

3.2 Affected environment

The affected environment represents existing conditions at the time this study was prepared.

The PEIS study area includes the industrial lands on which green hydrogen facilities are anticipated to be located, the surrounding viewsheds, and scenic resources. Industrial lands typically include large buildings with large outer signages, visible infrastructure like pipelines or electrical lines, and wide paved roads for parking and moving equipment. Types of industrial zoned areas or areas zoned to support industrial uses are further discussed in the *Land Use Technical Appendix*. Industrial lands include various land-intensive activities, often involving patterns of noise, light, and hours of operation. Lighting could stem from public street pole lamps, lights on the exterior of buildings and equipment, lights around signages, lights in parking spaces, lights and various other lighting for safety purposes. Within industrial lands, there are also multiple modes of transportation present, detailed further in the *Land Use Technical Appendix,* to support operations. These include ports and airports, which often include lighting at night on cranes, runways at airports, and surrounding the terminals. There are also commercial areas nearby such as gas stations, business parks, warehouses, restaurants, convenience stores, and other businesses supporting workers in industrial lands. Sometimes these commercial areas could be shared with manufacturing or industrial buildings termed commercial industrial, or mixed-use. Fewer green spaces are present in industrial lands. Typically, industrial lands have experienced ground disturbance because of development and are less likely to be identified as having scenic value. These areas generally have level terrain and are not located on ridgelines.

The level of development and population varies widely from large urban areas in the cities of Seattle, Bellingham, the Tri-Cities, Olympia, Spokane, Yakima, and Vancouver and their surrounding metropolitan areas. Other parts are in smaller cities such as Aberdeen, Anacortes, Centralia, Moses Lake, Port Angeles, Pullman, Walla Walla, and Wenatchee, and others are in small towns or rural areas near highways in between sparsely populated areas. Examples of industrial lands in rural areas include Richland Business Park (Richland, Washington), Midvale Industrial Park (Yakima County), Wallula Gap Business Park (Walla Walla County), and Watershed Business Park (Skagit County).

Human influences have altered much of the visual landscape of the study area and will continue to do so over the 75-year timeframe of this study, especially with respect to land use and land cover in industrial lands closer to urban areas. Urbanized areas have experienced development that has modified the landscape from vegetation, open land, and tidal flats to a built environment comprised of pavement, concrete, and structures. Areas such as Georgetown and SODO in Seattle, Port of Tacoma and Nalley Valley in Tacoma, Riverside Business Park in Everett, and Sumner-Pacific industrial lands between Kent and Puyallup have been developed to support industry and manufacturing. Interstates in the urbanized study area also contribute to the alteration of visual landscapes. Interstates have multiple traffic lanes that cover large swaths of land and dominate the landscape, which increases movement of people and goods that accommodate motor traffic. Areas without major interstates often have developments (e.g., buildings, structures) or other elements in the environment dominating the landscape with only single- or double-lane roadways supporting the development. Ports also alter the visual landscape of an area, consisting of large asphalt-surfaced land typically adjacent to a waterbody dedicated to fitting shipping containers and equipment. Industrial lands in rural parts of the state are usually adjacent to lands that are undeveloped, agricultural, or in the early stages of development. Hence, the introduction of visual landscape changes in rural industrial lands may have a more noticeable impact than those closer to urban areas.

It is possible to see for great distances in more rural surroundings, or where the study area borders a large body of water. In urban surroundings, buildings and other structures may block visibility. The landscapes surrounding the industrial areas in the study area include the Columbia River basin, the foothills of the Cascade Range, the Yakima Valley, the Palouse region, the Puget Sound region, and the Pacific coast. Level undeveloped areas with sparsely vegetated plains and plateaus or agricultural lands, large Tribal reservations, and federal and state government holdings also contribute to the undeveloped landscape, except for clusters of structures within those holdings.

The air quality, which affects visibility, varies depending on location and time of year. In areas with urban surroundings, air quality is generally lower than in areas with more rural surroundings, except during dust storms in central Washington. See the *Air Quality and Greenhouse Gases Technical Appendix* for more information.

Scenic resources in the study area include the Pacific Ocean and Puget Sound; mountain ranges such as the Olympic Mountains, Cascade Mountains and Kettle River Range; national and state parks, monuments, and recreation areas; historic sites, parks, memorials, and landmarks; National Wild and Scenic Rivers, national historic trails, scenic highways, undeveloped open plains or rolling hills, and national wildlife refuges; and other designated scenic resources. In addition, many other scenic resources are on federal, state, and other non-federal lands, including traditional cultural properties important to Tribes and state or locally designated scenic resources such as state-designated scenic highways, state parks, and county parks. Many of these designated scenic resources provide views of broad scenic vistas. Scenic resources could change (be added or removed) over the 75-year timeframe of this study.

For many individuals, their experience of the visual character includes views of the interstate, U.S., and state highways that cross the region, as these are roads that typically connect industrial lands to the rest of the state. Major roads include Interstate (I-)5, I-405, I-90, I-205, U.S. Highway (US) 395, State Route (SR) 18, SR 167, SR 512, SR 599. Other views include local roads, residential areas, or commercial areas near industrial lands. Tourism areas are not typically located in industrial lands. However, tourists are drawn to various scenic attractions near industrial lands and surrounding lands each year and contribute to making tourism a component of many regional and local economies.

There are National Scenic Byways, designated by the Federal Highway Administration, including Mountains to Sound, Coulee Corridor, and International Selkirk Loop (USDOT 2024). There are also more than 100 state-designated Scenic Byways distributed across every region of the state.

Industrial lands on which green hydrogen facilities are anticipated to be located are adjacent to three National Wild and Scenic Rivers: the Klickitat, Skagit, and Snake Rivers. There are also many rivers that may be designated as scenic by local codes or land use plans—including but not limited to the Chehalis, Columbia, Methow, Pend Oreille, Sauk, Snohomish, Spokane, and Yakima Rivers. Additionally, about 2% of the study area is within the Columbia River Gorge National Scenic Area.

Figure 2 and Figure 3 show the scenic byways and the Columbia River Gorge National Scenic Area that are in the study area.

Scenic resources are also areas that are sensitive to light and glare, including designated night sky areas. Industrial lands typically have urban surroundings with existing sources of light pollution, including security and safety lighting, streetlights, lighting from homes and other buildings, and outdoor lighting at parking lots and sports fields. In general, the undeveloped areas have dark night skies, with relatively few sources of light pollution. Designated night sky areas would likely be found in more rural areas. See Figure 4 below for light pollution in Washington in relation to the industrial lands on which green hydrogen is anticipated to be located. Light pollution is expected to increase with various forms of development in the study area over the 75-year planning timeframe as described in the *Cumulative Impacts Technical Appendix*.

Figure 2. Scenic byways and Columbia River Gorge National Scenic Area in the study area in western Washington

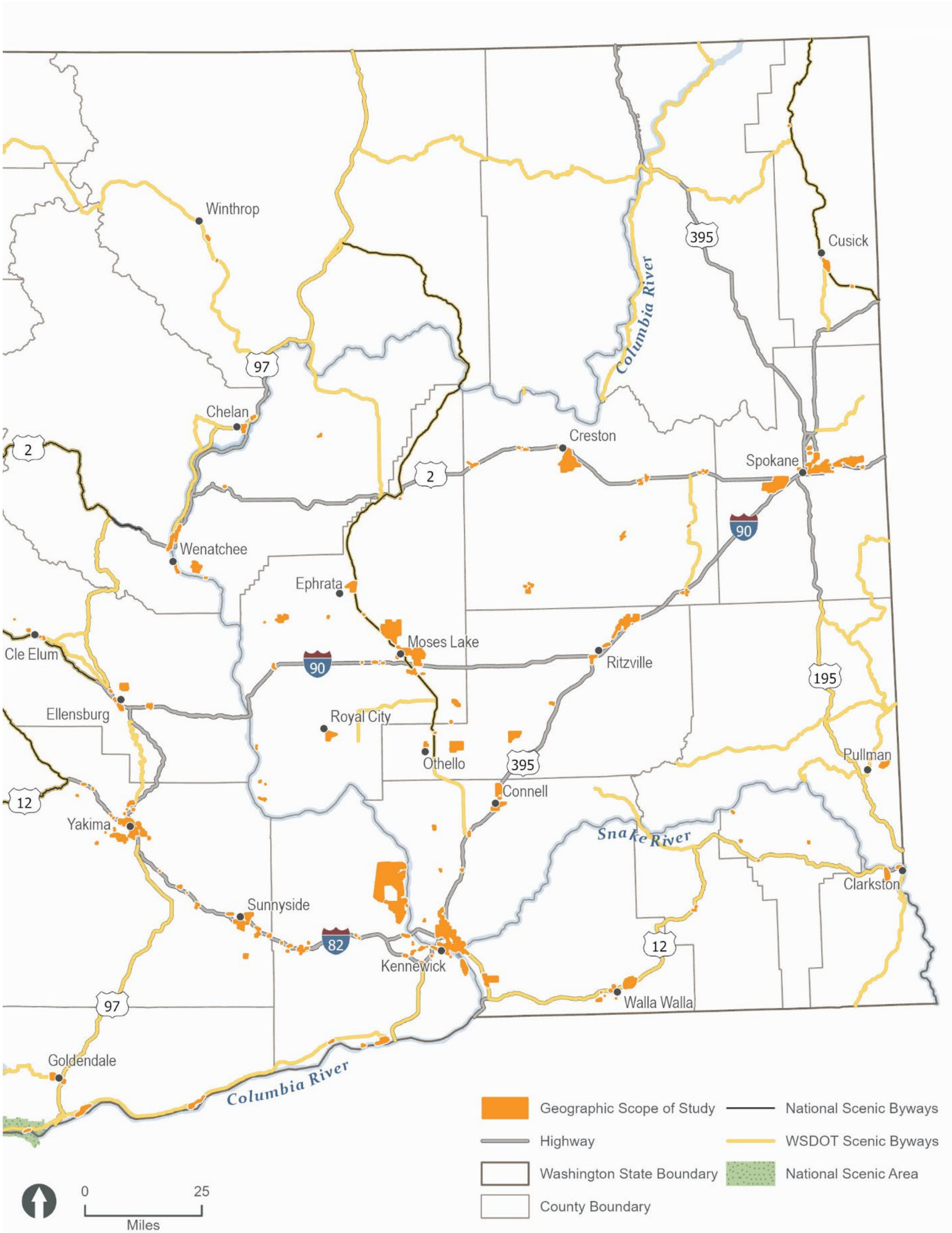

Figure 3. Scenic byways and Columbia River Gorge National Scenic Area in the study area in eastern Washington

Figure 4. Light pollution in the study area

Source: Román et al. 2018

Sensitive viewer groups are varied throughout the study area. These groups range from people occupying, working, or spending time near industrial lands to motorists, recreationists, and tourists. The viewing experience for each group would vary depending on the length of time and distance the viewer would be exposed to a green hydrogen facility and the physical conditions of the vantage point and viewshed. For instance, passengers in a vehicle traveling at highway speeds, pedestrian and bike path users, and visitors to scenic lookouts located approximately the same distance from a facility would view that facility for different lengths of time and would experience the effects of visual change resulting from the facility siting differently.

3.3 Potentially required permits

None of the federal or state laws, plans, and policies presented in Table 1 require permits related to aesthetics and visual quality. However, permits at the local level would require compliance with land use development ordinances that determine appropriate building characteristics (size, placement, height, bulk) for industrially zoned areas. Local development could regulate light pollution through dark sky ordinances or requirements related to safety or obstruction lighting. Local land use development ordinances may require some form of design approval in designated scenic corridors. Local land use permits may also require that projects demonstrate conformance with zoning and comprehensive plan designations, which may include areas of rural character.

3.4 Green hydrogen production facility

This section describes potential impacts of green hydrogen production facilities. For the purposes of the PEIS, the estimated footprint of a green hydrogen production facility, based on existing facilities in other areas, ranges from 1 acre to 10 acres and the estimated height of structures up to 100 feet, depending on the production method, type of storage facilities, and layout of external pipes and tanks, a parking area, and security fencing.

A green hydrogen production facility would typically include a connection to the electricity grid to power all, or a portion of, the facility's equipment needs and buildings. Facilities typically connect to the main transmission line through distribution lines, the length of which would be determined by the project developer, based on the distance between a selected site and existing electricity grid infrastructure and the height, estimated up to 100 feet. This technical appendix includes evaluation of impacts associated with distribution line connections to main transmission lines.

Off-site access roads may be needed to connect a facility to the existing state routes. Most of study area is less than 10 miles from a state route (63% within 1 mile and 99% within 10 miles). If needed, the project developer would determine the length of off-site access road needed, based on the distance between a selected site, existing road infrastructure, and coordination with state and local departments of transportation.

3.4.1 Impacts from construction and decommissioning

Site characterization would involve collection of data and site assessments that do not involve changes to the aesthetics and visual quality or introduction of new sources of light or glare. Generally, there would be little to no modification of the site and minimal to no site disturbance except for potential ground disturbance from soil coring and geotechnical investigations.

Construction of a green hydrogen production facility would occur similarly to construction of other industrial facilities and would involve a range of activities associated with potential aesthetics and visual quality impacts. Construction of a green hydrogen production facility would typically involve the following major actions with potential visual impacts:

- Establishing site access
- Vegetation clearing and grading (with associated debris)
- Constructing and using temporary staging and laydown areas
- Constructing and using vehicle access and service roads
- Erecting fencing and vehicle and pedestrian access gates
- Grading and constructing foundations for on-site buildings and support facilities (control rooms, maintenance equipment, storage areas for facility tools and materials, motor control centers, instrument air compressors, utility connections, hydrogen transfer stations or facility pipeline connections, water treatment infrastructure, and small-scale storage tanks for fuel to support on-site equipment such as generators or vehicles)
- Installing lighting for security, work and maintenance
- Installing and connecting to main transmission line through a distribution line
- Performing revegetation

Construction activities would vary based on the type of facility, size, and site characteristics. Construction could require demolition and clearing of buildings and facilities. The frequency and duration of construction activities would also be variable. There may be periods of intense activity followed by periods with less activity. Visual impacts would, to some degree, vary in accordance with construction activity levels. Construction-related visual impacts would take place during the 1–3 years of construction for an individual facility, but multiple facilities could be constructed over an estimated 25-year period.

3.4.1.1 Long-term change or reduction in visual quality

Vegetation clearing and excavation

The nature and extent of vegetation clearing depend on the requirements of the facility for site preparation, the types of vegetation, and other objects to be cleared. Industrial lands typically have less native and long-established vegetation than undisturbed areas. Invasive species are often present. Visual impacts associated with vegetation clearing include the potential loss of vegetative screening, which would result in the opening of views to the green hydrogen production facility.

While not likely in an industrially zoned area, in an area zoned to support industrial uses, or in undeveloped industrial areas, if the area is heavily vegetated, is in a location where vegetation clearing impacts are more conspicuous, or has strong color contrasts between vegetation and soil, construction impacts would be greater. However, uncleared vegetation outside the facility or other large buildings might screen views of the cleared areas, reducing visible contrast. In sparsely vegetated areas, visual impacts from vegetation clearing would typically be expected to be less because there would normally be less vegetation removal and there would be generally fewer contrast issues associated with vegetation removal in these areas. In areas where there is snowfall, the presence of snow cover may accentuate color contrast.

Excavation would damage or remove vegetation, expose bare soil, and suspend dust. Soil stockpiles (if not removed) could be visible for the duration of construction. Soil scars, exposed slope faces, eroded areas, and areas of compacted soil could result from excavation, leveling, and equipment or vehicle movement. Invasive species may colonize disturbed and stockpiled soils and compacted areas. These species may be introduced naturally in seeds, plants, or soils introduced for intermediate restoration or by vehicles. In some situations, the presence of invasive species may introduce contrasts with naturally occurring vegetation, primarily in color and texture.

The length of time required for vegetation to re-establish in disturbed areas varies greatly depending on location, weather patterns, soil fertility, surrounding land use, and the type of vegetation planted or recruited (e.g., grasses, forbs, shrubs, trees). Refer to the *Biological Resources Technical Appendix* for more discussion of vegetation.

Access roads and traffic

Constructing access roads and upgrading existing roads could be required to support facility construction and maintenance activities. Roads are expected to be topped with aggregate (gravel) or paved. Road development may introduce visual contrasts in the landscape, depending on the elevation compared to the surrounding roadways in industrial lands, the relationship of the routes to surface contours, and the widths, lengths, and surface treatments of the roads. Construction of vehicle access and service roads would have some associated residual impacts from vegetation disturbance that would be evident until vegetation re-establishes. Most industrial lands are anticipated to have existing established access, which would reduce the need for new access roads; however, where new access is required, roads are anticipated to be, less than 10 miles long. New roads would add linear contrast to the viewshed but are not likely to cause a significant change.

Traffic would produce visible activity and dust from dry soils. Suspension and visibility of dust would be influenced by vehicle speeds, road surface materials, and weather conditions. Temporary parking for vehicles would be needed at or near work locations. Unplanned and unmonitored parking could likely expand these areas, producing visual contrast due to suspended dust and loss of vegetation. Construction activities would involve several crews moving through a given area in succession, giving rise to brief periods of intense construction activity (and associated visual impacts) followed by periods of inactivity. Mobile cranes and other construction equipment would produce emissions while in operation and may create visible exhaust plumes.

Construction equipment, laydown areas, and other activities

Typical construction equipment includes graders, rubber-tired bulldozers, tractors, loaders, backhoes, excavators, cranes, forklifts, generators, welders, cement and mortar mixers, pavers, rollers, pile-drivers, air compressors, and trucks. Other visible items at the construction site could include vehicles, material stockpiles, and soil stockpiles.

The nature and extent of visual impacts associated with construction staging and laydown areas would depend in part on the size of the area and the nature of required clearing and grading, and on the types and amounts of materials stored at the staging and laydown areas. The presence of materials and equipment in these areas could introduce temporary changes in the visible landscape, and additional visual contrasts could be introduced by any vegetation clearing or grading required. Most of these areas would be restored to pre-project conditions immediately after completion of construction. However, some associated residual impacts (e.g., vegetation disturbance) could be evident for some years afterward, with a gradual diminishing of impacts over time.

The various construction activities described previously require work crews, vehicles, and large equipment that would add to the temporary visual impacts of construction. The presence of workers and construction activities could also result in litter and debris that could create negative visual impacts within and around work sites. Site monitoring, adherence to standard construction practices, and restoration activities discussed in Section 3.4.3 would reduce many of these impacts.

Other construction activities that could introduce visual contrast with existing landscape conditions include new or modified fencing, installation of road access gates, temporary modifications to pedestrian or vehicle traffic control, temporary additions of construction signage, and construction of foundations for buildings and equipment.

Existing views and contrast with viewsheds

If a visual resource is visible before construction begins, construction activities and facilities may block or detract from the visual resource. The type of visual resources that may be blocked would vary throughout the study area. During project-specific environmental reviews, key observation points (KOPs) could be selected during siting to identify the most critical locations in a specific area from which the green hydrogen facility may be seen to avoid blocking important visual resources.

Although industrial lands may already be developed such that adding green hydrogen facilities would be consistent with the existing visual character, some industrially zoned land may be undeveloped, or adjacent land may have visual resources that would be affected or changed by green hydrogen facilities. The appropriate viewshed analysis would be conducted at a project-specific level as determined by the lead agency.

Depending on the location, construction activities could contrast with the topography that makes up existing viewsheds. Siting of a facility in industrial lands with surrounding industrial developments would add to the impacts to that viewshed (see the *Cumulative Effects Technical Appendix*). If a facility is sited in a rural area, the likelihood of construction contrast with the topography of viewsheds would be greater than in a rural area. Additionally, the facility location could be in an area that is naturally blocked from view by intervening vegetation or topography.

Summary of construction and decommissioning impacts on visual quality
The study area includes industrially zoned areas or areas zoned to support industrial uses, and most green hydrogen facilities would be constructed in an industrialized setting of low scenic value with similar facilities already visible. Facilities sited in rural areas on undeveloped industrial lands would typically be more conspicuous and therefore perceived as having greater visual impact.

Some landscapes have special meaning to viewers because of unique scenic, Tribal, cultural, or ecological values and are therefore perceived as being more sensitive to visual disturbances. Depending on visibility factors, green hydrogen facilities constructed within or near sensitive landscapes such as state and national parks, historic sites, landscapes sacred to Tribes, scenic highways and trails, recreational attractions, and other valued cultural features may be of particular concern.

Industrially zoned land or land that supports industrial uses (such as ports and airports) is assumed to have had visual impacts considered through the local comprehensive planning process, and although there may be changes in viewsheds, they are not expected to be significantly different from adjacent areas.

Through compliance with laws and permits and with implementation of actions that could avoid and reduce impacts, construction activities would likely result in **less than significant impacts** on visual quality. Section 3.4.3 presents actions that could avoid or reduce construction impacts of green hydrogen energy facilities on the visual environment.

Green hydrogen production facilities would be decommissioned after their operational life up to 50 years, depending on the type of facility. Decommissioning would include dismantling and removing all structures associated with the green hydrogen facility and restoring to previous site conditions or as outlined in a decommissioning plan that would be prepared as part of the construction proposal. The facility site would be restored to pre-existing conditions unless the facility owner, permitting authority, and regulatory agencies agree on alternate actions.

Expected visual impacts of decommissioning activities would be similar to construction. Newly disturbed soils would create a visual contrast that could persist for several seasons before revegetation would begin to mature and restore the pre-facility visual landscape. Complete restoration of vegetation to pre-facility conditions may take much longer. As noted for construction, the time for vegetation to re-establish varies greatly. Decommissioning impacts would last until restoration of the site is complete. Refer to the *Biological Resources Technical Appendix* for more discussion of vegetation.

Through compliance with laws and permits and with implementation of actions that could avoid and reduce impacts, decommissioning activities would likely result in **less than significant impacts** on visual quality.

3.4.1.2 Light and glare

Construction of a green hydrogen production facility would be expected to occur during daylight hours. Facility construction would not introduce new, substantial sources of light that could affect daytime views in the vicinity. Some nighttime activities may be performed such as electrical connection, inspection, and testing activities. It is assumed that such activities would be performed with temporary lighting that would be directed downward to focus illumination on work areas and minimize impacts on neighboring properties in the vicinity of a facility.

Construction activities could temporarily increase glare in and around a facility site if activities were associated with an increased presence of reflective materials, potentially including construction equipment, new materials (i.e., not yet subjected to weathering), and vehicle windows. However, any increase in glare that could result from the presence of construction equipment or materials is expected to be minimal and temporary during construction.

Decommissioning would not likely include nighttime activities and would not create a source of lighting or introduce light pollution that would impact nighttime views. Although decommissioning activities would require the use of vehicles and equipment similar to those required for construction, sources of glare would be minimal and temporary, as equipment would be moved between active work locations on the facility site. Once the facility is decommissioned and dismantled, there would be no remaining permanent sources of light or glare.

Through compliance with laws and permits, and with implementation of actions that could avoid and reduce impacts, construction and decommissioning activities would likely result in **less than significant impacts** related to light or glare.

3.4.2 Impacts from operation

3.4.2.1 Long-term change or reduction in visual quality

Vegetation clearing

Permanent vegetation removal could be required for safety during operation. As a result, permanent vegetation removal could expose objects previously buffered by vegetation and produce dust from exposure of bare soil that could degrade general visibility of both day and night skies.

In naturally vegetated areas where bare soils become exposed (generally associated with construction activities), reclamation efforts would include reseeding these areas. Appropriate mitigation practice would include reseeding with native plants, which would minimize visual contrasts, but depending on circumstances, several years might pass before color and texture contrasts between reseeded and uncleared areas would no longer be noticeable. If a lack of proper management led to the growth of invasive species in the reseeded areas, noticeable color and texture contrasts might remain indefinitely. The unsuccessful reclamation of cleared areas may also result in soil erosion, ruts, gullies, or blowouts and could cause long-term negative visual impacts.

Other cleared areas could include roads (gravel or paved), fencing, and electrical distribution lines. Some support facilities would be surrounded by cleared areas. Visual contrasts associated with these cleared areas would include the potential loss of vegetative screening, which would result in the opening of views and visual changes. Clearing for distribution lines and roads would vary in size and type based on project location and might be subject to some linear contrast. The amount of clearing depends on the distance between the project location and existing transmission or distribution lines. The length of an electrical distribution line would depend on the distance from the site to existing transmission lines. The distance from the grid connection point would vary but is anticipated to be between 1 and 8 miles from existing transmission lines and would be determined by the developer based on a selected site. Since green hydrogen production facilities would be on industrial lands, the PEIS assumes that existing electric grid facilities are likely to be included in the vicinity which would shorten the length of transmission line connections. Clearing of vegetation for roads and distribution lines to support green hydrogen facilities would add linear contrast to the viewshed but is not likely to cause a significant change if the area is already industrially developed. The nature and extent of impacts due to permanent clearing of vegetation depend on the existing aesthetic and visual environment and the extent of clearing of vegetation required. Vegetation buffers could also be a requirement to reduce visual impacts as determined by the lead agency.

Facility components and buildings

Visual quality impacts from the demolition of buildings, introduction of facility components and buildings, and the potential for structures to block existing views would depend on the existing views, the scale of the facility, and the surrounding aesthetics and visual environment, and would likely need to be determined on a project-level basis.

Buildings common to green hydrogen facilities would include ancillary buildings for operations and maintenance, and infrastructure for lighting, security, service access, parking areas, electrical, and water management. The external materials of buildings and structures associated with green hydrogen facilities would be typical of industrial facilities: metal or concrete that has been painted. Lighting would be included on the exterior of facility components and buildings and, assuming that the land is already industrially developed, would be visually compatible with the high concentration of artificial lighting in the area. Facility components and buildings would be visually compatible with surrounding lands, if already industrially developed, and would be constructed in accordance with state and local regulations as well as applicable permits and processes. Examples of industrial facilities that consist of components and buildings visually similar to green hydrogen facilities includes Monolith's Olive Creek 1, a methane pyrolysis plant shown in Figure 5 below; Plug Power's liquid hydrogen plant shown in Figure 6 below; and Air Liquide's liquid hydrogen production plant shown in Figure 7 below.

Figure 5. Pyrolysis facility – Monolith Olive Creek – Hallam, NE

Source: Power Technology partnered with Mitsubishi Heavy Industries (MHI) Group 2022

Figure 6. Electrolysis facility – Plug Power – Woodbine, GA

Source: Lutz 2024

Figure 7. Steam-methane reforming and liquid storage facility – Air Liquide – Apex, NV

Source: Air Liquide 2022

Green hydrogen facilities and components would introduce various rectilinear forms of geometry, which would fit into industrial visual features and buildings if the site was previously industrially developed. Neutral-colored treatments or coatings are used on these components and buildings to ensure uniformity with adjacent industrial properties and to minimize visual contrast with surroundings. This is shown in an example in Figure 8, where only neutral colors such as white and gray colored coatings are used on the exterior of structures.

Figure 8. Fukushima Hydrogen Energy Research Field (FH2R) – Fukushima, Japan – electrolysis and gaseous storage facility

Source: Government of Japan 2021

The shapes of buildings are typically rectangular and uniform, with varying sizes, as shown in an example facility in Figure 9 and Figure 10. Forms of other miscellaneous structures may be spherical or cylindrical-shaped such as towers, tanks, or pipes, but these forms would not visually dominate the landscape (see Figure 11). Facades of facility components and buildings may have a few simple textures; however, generally these infrastructures would have a smooth concrete or metal surface on their facades. Concrete stairways and gravel walkways are anticipated. If the surrounding landscape character is dominated by industrial buildings similar to green hydrogen facilities, surrounding aesthetics and visual environment would not be greatly impacted due to the existing industrial character of the landscape. If the site is undeveloped, however, or surrounding areas are also undeveloped, potential impacts could be greater.

Figure 9. Electrolysis facility – H2B2 SoHyCal – Fresno, CA

Source: H2B2 Electrolysis Technologies 2023

Figure 10. Electrolysis facility – Air Liquide HyBalance – Hobro, Denmark

Source: Air Liquide 2020


Figure 11. Example of a liquefaction system

Operation and maintenance activities

Operational activities would include the production of hydrogen using one of the four processes: electrolysis, steam-methane reforming (SMR), pyrolysis, or bio-gasification. The SMR, pyrolysis, and bio-gasification processes could generate air emissions. These activities could be visible off site and might also generate visible dust plumes in some circumstances.

Combustion of renewable natural gas in boilers may generate visible steam as part of the SMR process.

Maintenance roads would be paved or gravel. Roads may introduce visual contrasts to the landscape, depending on width, length, surface treatment, and route relative to surface contours. Improper road maintenance could lead to the growth of invasive species or erosion, both of which could introduce undesirable visual contrasts. Most industrial lands that have been developed are anticipated to have existing established access, which would reduce the need for new access roads.

Summary of operation impacts on visual quality

Depending on the location, the introduction of a green hydrogen production facility could contrast with existing views and the topography that makes up existing viewsheds. The degree of visual impact for a green hydrogen facility is determined in part by the number of viewers who experience the impact, as well as the type of activities viewers are engaged in when viewing a visual impact and their sensitivity to visual impacts. In urban areas with high population density and existing industrial developments, more viewers could potentially view the facility, but their sensitivity to industrial developments would be lower due to the existing urban and industrialized setting. In areas with lower population density, green hydrogen facilities may be visible for long distances, but they would generally be viewed by few people. Impacts on residents are generally greater than those on more transient viewers such as drivers or workers, in part because residents are likely to view green hydrogen facilities more frequently and for longer durations.

As described for construction, most green hydrogen facilities would be constructed in an industrialized setting of low scenic value with similar facilities already visible. Facilities sited in rural areas on undeveloped industrial lands would typically be more conspicuous and therefore perceived as having greater visual impact. Some landscapes have special meaning to some viewers, and green hydrogen facilities constructed within or near sensitive landscapes may be of particular concern. Through compliance with laws and permits, and with implementation of actions that could avoid and reduce impacts, operation activities would likely result in **less than significant impacts** on visual quality. Section 3.4.3 presents actions that could avoid or reduce operation impacts of green hydrogen facilities on the visual environment.

3.4.2.2 Create new source of light or glare

Operation of a green hydrogen production facility would have staff on site 24 hours per day, 7 days per week, though smaller facilities may have limited staffing hours with remote operation. Green hydrogen facilities would require ongoing equipment maintenance similar to other industrial facilities. Lighting would be needed for security, work, and maintenance. The external lighting at a green hydrogen production facility would be typical of lighting used for industrial facilities. There would be lights around buildings, parking areas, and other outdoor structures that are illuminated at nighttime for security purposes. These could produce light pollution if best management practices are not followed, such as designing facilities to keep outdoor lighting to the minimum required and use motion sensors wherever possible; using hooded or downward-directed lighting; and avoid steady-burning or high-intensity lights.

The external materials of buildings and structures associated with green hydrogen energy facilities are typical of industrial facilities: metal or concrete that has been painted. These surfaces are unlikely to produce glare if non-reflective finishes and coatings are used (see mitigation measures in Section 3.4.3.2).

Light or glare associated with facility operation would not introduce new, substantial sources of light or glare that could affect daytime views if the green hydrogen facility were in industrial lands because these areas generally have existing sources of light and glare. Facilities sited in rural areas on undeveloped industrial lands could experience new light or glare. Safety and security lighting may be active during non-daylight hours, which could affect nighttime views and visual impacts towards military and commercial aircraft. If in the vicinity of a visually sensitive environment, light or glare associated with facility operation could introduce new, substantial sources of light or glare. The extent of light and glare impacts from a green hydrogen facility would depend on the conditions of the specific site and surrounding areas.

Through compliance with laws and permits, and with implementation of actions that could avoid and reduce impacts, operation activities would likely result in **less than significant impacts** related to light or glare.

3.4.3 Actions to avoid and reduce impacts

Siting and design considerations are actions that could be taken by a developer when developing a facility design or considering a site. These are intended to result in the avoidance, minimization, and/or mitigation of potential resource impacts. The greatest potential for visual impacts associated with green hydrogen facilities and associated facility components would occur as a result of decisions made during the siting and design of the facilities. In many cases, visual impacts associated with these facilities could be avoided or substantially reduced by careful facility siting.

3.4.3.1 Siting and design considerations

- Locate facilities near existing electricity transmission to minimize the need for additional electrical infrastructure.
- Include a visual resource specialist on the planning team to evaluate visual impacts.
- Conduct a detailed visual resource analysis to identify and map landscape characteristics, KOPs, and key viewsheds; prominent scenic, Tribal, and cultural landmarks; and other visually sensitive areas near the facility location.
- Consult with the appropriate land management agencies, planning entities, Tribes, and the local public early to provide input on the identification of important visual resources near a facility site and on the siting and design process.
- Use geographic information system tools and visual impact simulations for conducting visual analyses (including mapping), analyzing the visual characteristics of landscapes,

visualizing the potential impacts of facility siting and design, and fostering communication.
- Avoid locating facilities that would alter the visual setting and reduce the historic significance or function.
- Site facilities outside the viewsheds of KOPs, highly sensitive viewing locations, and areas with limited visual absorption capability or high scenic integrity. If they must be sited within view of KOPs, they should be as far away as possible, as visual impacts generally diminish as viewing distance increases.
- In already developed landscapes, consider visual absorption capacity and possible cumulative effects.
- Locate facilities on sites that require minimal clearing of native vegetation.
- Design facilities to visually integrate with the surrounding landscape
- Design facilities to minimize light pollution:
  - Use the International Dark Sky Association's Five Principles for Responsible Outdoor Lighting to design outdoor lighting.
  - Keep outdoor lighting to the minimum required for safety and security. Use motion sensors to keep lighting turned off when not required.
  - Use hooded, downward-directed lighting to minimize light pollution and prevent lighting from projecting onto adjacent properties.
  - Avoid steady-burning, high-intensity lights.
- Design facilities to prevent glare:
  - Use non-reflective materials or non-specular finishes and coatings on facilities to the greatest extent feasible to prevent glare.
- Design facilities to comply with applicable land use regulations related to light, glare, building height, setbacks, vegetation screening, exterior storage, fencing, and any other requirements related to the visual appearance of the facility.
- Design the facility to comply with Federal Aviation Administration obstruction avoidance and safety and glare avoidance requirements.

3.4.3.2 Permits, plans, and best management practices

As noted in Section 3.3, none of the federal or state laws, plans, and policies presented in Table 1 require permits related to aesthetics and visual quality. Local land use development ordinances may require some form of design approval (e.g., in designated scenic corridors) or night sky exemption related to safety or obstruction lighting.

3.5 Green hydrogen production facility with co-located battery energy storage system (BESS)

This section describes potential impacts of green hydrogen production facilities with up to two co-located BESS containers. The BESSs would be used to balance loads or to provide up to 15% of power in case of an outage or power quality deviation. One BESS would provide 2.85 megawatts of electricity for 4 hours (a capacity of 11.4 megawatt hours or 11,400 kilowatt hours). Each container would be approximately 60 by 12 feet wide and 10 feet tall.

3.5.1 Impacts from construction, operation, and decommissioning

3.5.1.1 Long-term change or reduction in visual quality

Site characterization and construction activities for green hydrogen production facilities with co-located BESSs would be the same as those for green hydrogen production facilities. For this analysis of visual quality, it is assumed that the BESS would be co-located with the green hydrogen production facility and would require a small additional area of development. BESSs are usually installed in a graveled area where vegetation clearing, and gravel surfacing would be required. Installation of the BESS would be similar to the construction of other support facilities and structures included in a green hydrogen production facility.

During operations, the addition of a BESS would not change or reduce the visual nature of green hydrogen production facility.

Decommissioning of a green hydrogen production facility with a BESS would involve the additional decommissioning of the BESS, which is similar to the removal of other support facilities.

Through compliance with laws and permits, and with implementation of actions that could avoid and reduce impacts, construction, operation, and decommissioning activities would likely result in **less than significant impacts** on visual quality.

3.5.1.2 Create new source of light or glare

The additional BESS construction may require nighttime work lighting; however, these activities would be occasional and temporary, and the light would be shielded downward as described for green hydrogen facilities. The potential for nighttime lighting during construction to impact nighttime views would be minimal, and the BESS would not introduce new, substantial sources of glare that could affect daytime views in the vicinity.

During operations, the addition of a BESS would not change the sources of light and glare of a green hydrogen production facility.

The impacts of both light and glare during decommissioning would be like those identified for construction. As the facility site would be restored to pre-project conditions following the operational life of the facility, there would be no remaining permanent sources of light or glare.

Through compliance with laws and permits and with implementation of actions that could avoid and reduce impacts, construction, operations, and decommissioning activities would likely result in **less than significant impacts** related to light or glare.

3.5.2 Actions to avoid and reduce impacts

The measures to minimize, reduce, and mitigate aesthetic and visual quality impacts for facilities with a BESS would be the same as those described in Section 3.4.3, including the measures related to siting and design that could also be applied to the BESSs. Refer to Section 3.4.3 for a full discussion of those measures.

3.6 Green hydrogen storage facility (gas or liquid form)

This section describes potential impacts of green hydrogen production facilities with hydrogen storage. A green hydrogen storage facility could store hydrogen in gas or liquid form. Gaseous hydrogen would be stored in stationary, aboveground, cylindrical storage systems, each of which employs different construction materials to achieve maximum working pressure ratings. Liquid hydrogen would be stored in double-walled, vacuum-insulated cryogenic storage tanks. The footprint of storage facilities would depend on the amount of hydrogen needed to store but would be less than 1 acre. This includes the storage tanks, separation space between tanks (if more than one), on-site access roads, and ancillary equipment.

A green hydrogen storage facility may be co-located with a green hydrogen production facility, or it may be located at a standalone facility, transport terminal, or end-use location such as an industrial facility or fueling facility.

3.6.1 Impacts construction, operation, and decommissioning

3.6.1.1 Long-term change or reduction in visual quality

Site characterization and construction activities for a green hydrogen production facility with hydrogen storage would be the same as those for a green hydrogen production facility described in Section 3.4.1.1, with the addition of installing hydrogen storage facilities. Installation of hydrogen storage facilities is similar to the installation of other support facilities and structures included in a production facility. For example, site preparation for hydrogen or liquid storage would require vegetation clearing. Alternatively, hydrogen storage could be at a stand-alone facility, at a transport terminal, or transported off site. Locating at a transportation terminal or transported off site may have similar or fewer visual impacts than described in Section 3.4.1.1, given that the existing built environment should typically have established access or cleared vegetation.

The operation of green hydrogen storage facilities would not change or reduce the visual nature of green hydrogen production facility development.

Decommissioning activities are similar to construction and require work crews, vehicles, and equipment that would add to visual impacts, but likely over a shorter period of time than construction. Decommissioning of a green hydrogen storage facility would involve the same activities as decommissioning a production facility, as described in Section 3.4.1.1, with the additional action of decommissioning the storage facilities, which is similar to the removal of other support facilities.

Through compliance with laws and permits and with implementation of actions that could avoid and reduce impacts, construction, operation, and decommissioning activities would likely result in **less than significant impacts** on visual quality.

3.6.1.2 Create new source of light or glare

Site characterization and construction activities required for a green hydrogen production facility with hydrogen storage, hydrogen storage as a standalone facility, at transport terminal, or transported off-site would be the same as those described in Section 3.4.1. The additional construction of hydrogen storage facilities may require nighttime lighting; however, these activities would be occasional and temporary, and the lighting would be shielded downward as described in Section 3.4.1. Therefore, the potential for nighttime lighting during construction to impact nighttime views would be minimal. Hydrogen storage facilities would not introduce new, substantial sources of glare that could affect daytime views in the vicinity.

The operation of green hydrogen storage facilities would not create any new sources of light and glare and would have similar impacts as green hydrogen production facilities described in Section 3.4.2.2.

The impacts of both light and glare during decommissioning and site restoration would be similar to those identified for construction. Decommissioning of a green hydrogen storage facility would involve the same activities as decommissioning green hydrogen production facilities described in Section 3.4.1.2, but likely over a shorter period of time. Decommissioning green hydrogen storage facilities is also similar to the removal of other support facilities.

Through compliance with laws and permits and with implementation of actions that could avoid and reduce impacts, construction, operations, and decommissioning activities would likely result in **less than significant impacts** related to light or glare.

3.6.2 Actions to avoid and reduce impacts

The measures to minimize, reduce, and mitigate aesthetic and visual quality impacts for a green hydrogen storage facility would be the same as those described in Section 3.4.3, including the measures related to siting and design that could also be applied to the storage facility components. Refer to Section 3.4.3 for a full discussion of those measures.

3.7 No Action Alternative

Under the No Action Alternative, agencies would continue to conduct environmental review and permitting for green hydrogen facilities under existing state and local laws on a project-by-project basis. The potential impacts would be similar to the impacts for the types of facilities described above for construction, operations, and decommissioning, depending on facility size and design. Facilities would result in a **less than significant impact** attributable to visual quality and light and glare.

3.8 Unavoidable significant adverse impacts

Through compliance with laws and permits, and with implementation of actions to avoid and mitigate significant impacts, green hydrogen facilities would have **no significant and unavoidable adverse impacts** on aesthetics or visual quality from construction, operation, or decommissioning.

4 References

Román, M.O., Z. Wang, Q. Sun, V. Kalb, S.D. Miller, A. Molthan, L. Schultz, J. Bell, E.C. Stokes, B. Pandey, and K. C. Seto et al., 2018. NASA's Black Marble nighttime lights product suite. *Remote Sensing of Environment* 210, 113–143. doi:10.1016/j.rse.2018.03.017.