Appendix C
Technical Supplement to the Noise and Vibration Discipline Report

Elliott Bay Seawall Project

Technical Supplement to the Noise and Vibration Discipline Report

FINAL

December 2013

Submitted to:

City of Seattle
Department of Transportation
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Elliott Bay Seawall Project

TECHNICAL SUPPLEMENT
NOISE AND VIBRATION DISCIPLINE REPORT

Agreement No. T09-24

FINAL

December 2013

The Elliott Bay Seawall Project is a joint effort between the City of Seattle Department of Transportation (SDOT) and the U.S. Army Corps of Engineers. To conduct this project, SDOT contracted with:

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City of Seattle

TECHNICAL SUPPLEMENT
NOISE AND VIBRATION DISCIPLINE REPORT

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ACRONYMS, ABBREVIATIONS, AND DEFINITIONS

dBA	A-weighted decibels
DEIS	Draft Environmental Impact Statement
EBSP	Elliott Bay Seawall Project
FEIS	Final Environmental Impact Statement
SDOT	Seattle Department of Transportation
SEIS	Supplemental Environmental Impact Statement
SEPA	State Environmental Policy Act

CHAPTER 1. PROJECT DESCRIPTION

1.1 BACKGROUND

The Elliott Bay Seawall Project (EBSP) Final Environmental Impact Statement (FEIS) was published in March 2013; it evaluated a No Action Alternative and three potential build alternatives for the project. As required by the Washington State Environmental Policy Act (SEPA), the build alternatives represented different ways of accomplishing the project purpose of protecting the shoreline and upland areas from damage due to coastal storms and seismic events, and improving the nearshore ecosystem of Elliott Bay. The three build alternatives (Alternative A, Alternative B, and Alternative C) encompassed a range of design ideas to establish "bookends" for the project, thereby capturing a suite of potential options and effects.

Alternative C was identified by the City as the Preferred Alternative and continued into final design and construction. Since publication of the FEIS, several changes have been proposed to the project design and construction methods. The City has determined that the proposed changes have the potential to result in significant adverse impacts that were not evaluated in the FEIS, and therefore is preparing a Supplemental Environmental Impact Statement (SEIS) to review only those project elements that have changed from the Preferred Alternative.

This addendum supplements the Noise and Vibration Discipline Report from the FEIS. It discusses the potential impacts on noise from the Updated Preferred Alternative. Material already covered in the FEIS, including affected environment, impact analysis, and mitigation, is not reproduced in this document.

1.2 UPDATES TO THE PREFERRED ALTERNATIVE

The Preferred Alternative consists of three major components, including a new seawall, improvements to aquatic habitat, and enhanced upland areas. The Updated Preferred Alternative proposes changes to two of these components: the seawall and aquatic habitat. The proposed changes are summarized below; please see Chapter 2 of the SEIS for more detail.

Table 1-1 provides an overview of the differences between the Preferred Alternative and the Updated Preferred Alternative. Figure 1-1 at the end of this chapter depicts a typical construction sequence for the Updated Preferred Alternative.

1.2.1 Seawall

The seawall would be replaced as planned under the Preferred Alternative. However, the extent of the setback would change somewhat in Zones 1 and 2. The 15-foot setback in Zone 1 would be eliminated; instead, the existing gravity wall would be demolished down to the appropriate level to provide support for the habitat beach. In Zone 2, the setback would range from 10 to 15 feet landward, similar to the setback in Zone 3. The setback in all other zones would remain the same.

TABLE 1-1 PROPOSED CHANGES TO THE PREFERRED ALTERNATIVE

Project Feature	Preferred Alternative	Updated Preferred Alternative
Project Design		
Seawall improvements	15-foot landward setback in Zone 1	No setback in Zone 1 and slightly reduced setback in Zone 2
Roadway improvements	Southern terminus at S. Washington Street	Southern terminus at S. Main Street
Habitat improvements	Extended habitat benches between each of the piers	Modifications to minimize adverse effects, accommodate operational constraints at Colman Dock, and avoid conflicts with navigation
Construction Schedule		
Construction completed	Target construction date: mid-2016 Two summer shutdown periods (Memorial Day – Labor Day 2014 and 2015)	Target construction date: mid-2016 Work may continue through summers to ensure timely completion of the project
Waterfront business closures	Potential temporary closure of two businesses	Closure of most businesses on Piers 54 to 57, currently planned for the nine month off-peak period between October 2014 and June 2015
Pier access	Temporary access bridges to all piers required throughout construction	Reduced number of temporary access bridges during construction
Construction Methods		
Ferry Queuing	Ferry-queuing provided on Alaskan Way, north of Colman Dock, between Madison Street and Yesler Way	Beginning in summer 2014, ferry-queuing would switch to south of Colman Dock, between Yesler Way and S. Jackson Street
Temporary containment	Sheet pile containment wall would be installed prior to jet grouting and removed at the end of construction	Containment provided by sheet pile, turbidity curtain, and/or other methods as feasible and appropriate to protect water quality. Containment wall would be cut to allow a portion to remain as vertical support for the habitat bench in some areas
Zone 1 beach stability	Geotextile used to support aquatic materials and increase stability of existing soils	Geotextile and sheet piles to support aquatic materials and increase stability of existing soils
Water management	Intermittent dewatering in excavation zone landward of existing seawall	Up to continuous dewatering in all excavation areas behind containment wall

Project Feature	Preferred Alternative	Updated Preferred Alternative
Soil improvement	Jet grouting from on top of the existing roadway prior to excavation	Jet grouting from on top of the existing roadway and within the excavated work zone in some areas along the seawall
Construction sequence	See Figure 2-10 in the Final EIS	See revised typical construction sequence example in Figure 1-1

1.2.2 Habitat Improvements

In response to conflicts with adjacent uses, the overall extent and design of the expanded habitat benches would be changed in the Updated Preferred Alternative.

The habitat beach located in Zone 1 is in close proximity to the Washington Street Boat Landing, which is a historic property listed in the National Register of Historic Places. To minimize the adverse effect to this property, the size of the beach, height of the confining rock sills, and extent of the riparian plantings would be slightly reduced. The beach would also be shifted slightly southward to provide a larger setback from Colman Dock. In addition, aesthetic design elements or treatments may be incorporated into the natural features of the beach in a form consistent with its purpose to enhance riparian and intertidal habitat.

To reduce potential conflict with existing boat moorage businesses in Zone 3, the waterward extent of the expanded habitat bench north of Pier 56 would be reduced. Also in Zone 3, the expanded habitat bench north of Pier 54 would be removed because it is located on privately owned property.

In Zone 6, the expanded habitat bench north of Pier 69 would be eliminated from the project design to minimize potential impacts to existing moorage space managed by the Port of Seattle. The expanded habitat bench north of Pier 66 is being evaluated for its potential to affect future moorage opportunities.

Despite the changes, the habitat enhancements are still expected to meet the project purpose of improving the nearshore habitat of Elliott Bay.

1.2.3 Upland Improvements

The Updated Preferred Alternative would not change the project's upland improvements.

1.2.4 Construction Schedule

Construction of the Central Seawall began in November 2013. Due to the seawall's importance as critical infrastructure and as a foundation for other independent waterfront improvement projects, the City is committed to completing Central Seawall replacement in 2016.

Because project construction is a complex and dynamic process, it is susceptible to schedule changes due to changed field conditions, availability of materials, extreme weather events, and many other factors. To ensure that the project is completed on time, construction is now likely to continue through the summers of 2014 and 2015. The most critical construction activities would continue as needed

during the summer months to recover any time lost to unanticipated schedule delays; additional efficiencies would also be gained by eliminating the need for demobilization and remobilization.

Summer activities could range from minor utility and roadway work to jet grouting and seawall reconstruction. The City would strive to minimize impacts on waterfront businesses, residents, and visitors by limiting summer activities to the greatest extent feasible that is consistent with timely project completion, and by implementing the access and wayfinding measures described in Chapter 8 of the Final EIS.

As described in the EIS, access to the piers will generally be provided throughout project construction. However, most businesses on Piers 54, 55, 56, and 57 are now expected to close for a period of approximately nine months, currently planned to extend from October 2014 through June 2015. This closure would eliminate many challenges related to maintaining pier access across an expansive construction zone and would thereby allow construction to proceed more efficiently. The Great Wheel and Argosy Cruises would remain open during this period, along with some office spaces (Argosy Cruises may move its passenger access to nearby piers). Limited access to Piers 54 through 57 would be provided during the business closure period for those businesses that remain open; access to all facilities on these piers would be available before and after the closure period. Access to the piers located outside of the business closure area would be maintained throughout project construction by way of temporary structures or revised access points.

With these modifications, Central Seawall construction is anticipated to be substantially complete by mid-2016, the target completion date identified in the EIS. However, if unanticipated delays were to occur, it is possible that final construction activities could continue after that date until the project is completed.

1.2.5 Construction Methods

1.2.5.1 Ferry Queuing during Construction

A new access route for Colman Dock is proposed as part of the Updated Preferred Alternative. Beginning in summer 2014, the U-turn at Madison Street would be eliminated; instead, all ferry-bound traffic would enter Colman Dock from the south. The new route would provide ferry-queuing spaces on Alaskan Way to the south. This change would relocate the ferry-queuing lanes to an area outside of the active work zone, and it could provide more queuing space than the Preferred Alternative. Relocating ferry-queuing lanes to the south would also provide additional space for parking within the project area.

1.2.5.2 Temporary Containment

Use of the temporary containment wall has changed in two aspects since the FEIS.

- The temporary containment wall would be used where feasible. However, other types of containment (such as a turbidity curtain) would be used to isolate construction activities from Elliott Bay when a containment wall is not feasible.
- Rather than being removed completely, the containment wall would be cut off just below the top of the habitat improvements in portions of Zone 4 and Zone 3.

1.2.5.3 Zone 1 Beach Stability

In coordination with Washington State Ferries, an analysis was done to address concerns related to the protection of Colman Dock from potential instability of the Zone 1 beach. The City concluded that additional geotechnical reinforcement would be necessary to strengthen the existing sediments and therefore increase the stability of the habitat beach. Before a geogrid reinforcement is placed, two parallel rows of sheet pile would be driven into the glacially overridden Quaternary deposits or dense soils. The geogrid and sheet piles would be buried beneath the mudline. The sheet pile rows would be positioned beneath the northern slope of the habitat beach, and each row would be approximately 100 to 200 feet in length. Vibratory pile drivers would be used for most of the installation, with only limited need for impact pile driving. In combination with the geogrid reinforcement, the sheet piles would stabilize the Zone 1 habitat beach, increasing stability during a seismic event and reducing potential impacts to adjacent structures.

1.2.5.4 Water Management

To create drier conditions for construction, the contractor has determined that a larger area would be dewatered. Dewatering generally involves pumping the water to a location where it can be settled and/or treated before discharge. The water treatment would occur onsite. Due to space limitations, treatment may be staged on land, as space allows, or on a barge, which would most likely be located at Piers 62/63 (although its location could change based on construction requirements). Once treated to meet the water quality requirements specified by the Department of Ecology, the water would be discharged to Elliott Bay. In some cases, water may be discharged to the King County wastewater treatment system or disposed of offsite.

1.2.5.5 Soil Improvement

To enhance constructability and overall understanding of site conditions, substantial portions of the construction work zone would be excavated before jet grouting begins. This technique would reduce the number of potential obstructions, eliminate void spaces, and provide more reliability for the final jet grout column layout compared to jet grouting from the roadway surface. Jet grouting would still occur from the roadway surface in some areas where major excavation is not reasonable.

1.2.5.6 Use of Barges

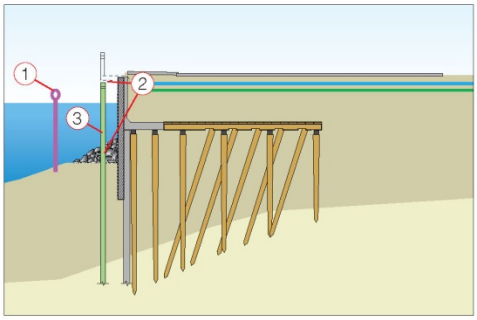
In addition to the activities described in the FEIS, barges may also be used for staging of some construction processes. For example, tanks and ancillary water treatment equipment could be placed on a barge. This would allow these types of operations to occur in close proximity to the project area, but outside of the confined construction work zone.

1.2.6 Construction Sequence

As design has progressed and construction techniques have been further developed by the project team and the contractor, a modified construction sequence has been developed to increase efficiency. The

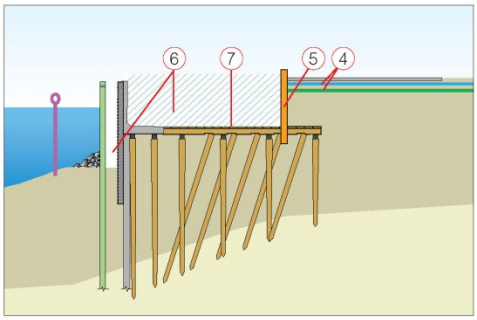
main construction steps described in the EIS will continue to occur, but they may be in a different order in the overall construction sequence.

Figure 1-1 provides a typical overview of how the seawall could be built with the revised approach. Construction would generally follow these steps in sequence through the active work zone; however, the sequencing and execution would vary between the different seawall types. It is also important to note that not all of the steps would occur at each location, and the construction sequencing may change depending on the site conditions and other factors encountered and evaluated during construction.



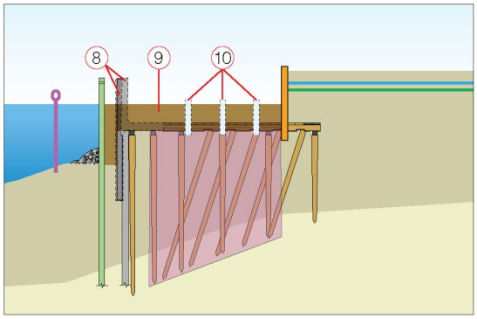
Updated Preferred Alternative, Stage 1

1. *Install turbidity curtain in Elliott Bay*
2. *Remove existing sidewalk and riprap in Elliott Bay*
3. *Install containment in Elliott Bay*



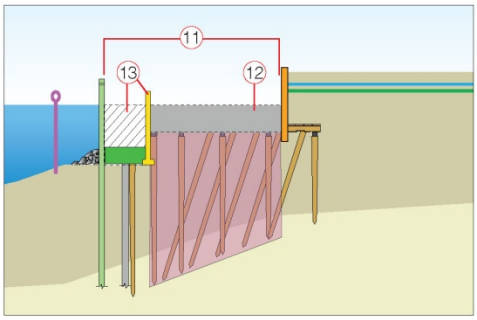
Updated Preferred Alternative, Stage 2

4. *Relocate utilities temporarily*
5. *Install shoring wall*
6. *Dewater the work area*
7. *Excavate to timber relieving platform*



Updated Preferred Alternative, Stage 3

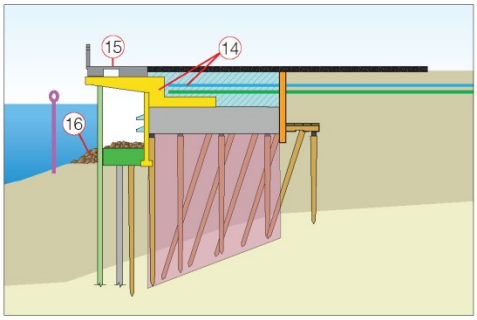
8. *Remove relieving platform and existing seawall face panels*
9. *Backfill within work area*
10. *Install soil improvement with jet grouting*



Updated Preferred Alternative, Stage 4

11. *Excavate backfill material to the improved soil mass and excavate pull back area*
12. *Pour cast in place support slab*
13. *Install new face panels and habitat bench*

Figure 1-1 Typical construction sequence for the Updated Preferred Alternative

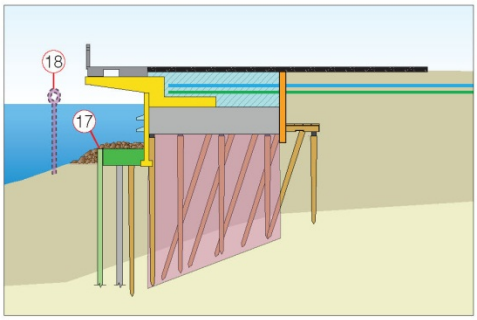


Updated Preferred Alternative, Stage 5

14. Install superstructure and restore utilities

15. Install cantilevered sidewalk with light penetrating surface

16. Install remaining habitat features within Elliott Bay



Updated Preferred Alternative, Stage 6

17. Cut off or remove containment

18. Remove turbidity curtain within Elliott Bay

Figure 1-1 Typical construction sequence for the Updated Preferred Alternative (continued)

CHAPTER 2. AFFECTED ENVIRONMENT

There are no changes to the affected environment since the FEIS.

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CHAPTER 3. CONSTRUCTION EFFECTS

As with all the alternatives outlined in the FEIS and for similar reasons, the Updated Preferred Alternative (described in Chapter 2 of the DSEIS) would have short-term, moderate adverse effects on the noise environment. These effects would be primarily due to in-air and underwater construction noise and vibrations from construction activities. With the exception of the water treatment system, heavy equipment and pile-driving noise would end once construction was complete and would not be concentrated in any one area for the entire project. The construction would take place over the duration of the project and would affect a variety of both residential and commercial properties. These effects, therefore, would be moderate.

Although the overall effects to noise and vibration would be similar in both nature and overall level as those outlined in the FEIS, updates to the Preferred Alternative would change some of the details about how and when the effects would take place. This Technical Supplement to the Noise and Vibration Discipline Report will address these changes as well as clarify some effects outlined in the FEIS based on current information. This report specifically includes discussions on:

- Noise effects due to summer construction and changes in sequencing;
- Noise effects on the pedestrian environment; and
- The use of barges near Pier 62/63 for water treatment.

3.1 SUMMER CONSTRUCTION AND CHANGES IN SEQUENCING

Under the Updated Preferred Alternative, construction would continue through the summers rather than shutting down for the summer months. Although the construction activities and corresponding noise levels would not change, the number of people experiencing the noise would be greater because of the higher volumes of people who frequent the waterfront area in the summer. The overall duration of construction noise compared to levels evaluated in the FEIS could be somewhat longer due to summer work and potential extension of construction longer in 2016. Heavy equipment noise would be temporary in nature and end with the construction phase. However, due to the proximity to nearby residences and businesses these effects would be moderate.

Construction-related noise under the Updated Preferred Alternative would continue through the summers and would generally focus on the areas north and south of Zone 3 during these periods. Although somewhat controlled, construction noise from Zones 2 and 4 would be audible and periodically intrusive to businesses in Zone 3 and residences along Alaskan Way during this period. This would be particularly true for businesses with outdoor seating and both businesses and residences that rely on open windows for regulating indoor temperatures. Most areas in Zone 3 do not have direct line-of-sight to Zones 2 and 4, and much of the heavy equipment noise would be blocked by Piers 57 and 54, thereby creating a relatively quiet area in Zone 3. Although construction activities would be similar to those described in the FEIS, the number of people exposed to this noise would be greater during the summer months.

3.2 NOISE EFFECTS ON THE PEDESTRIAN ENVIRONMENT

Pedestrians on temporary walkways and those accessing the waterfront directly adjacent to work areas would be exposed to heavy equipment noise during periods of construction. Noise levels would range from relatively quiet to loud depending on the construction activity taking place.

There are no specific not-to-exceed thresholds for determining the effects of noise on pedestrians. However, it is acknowledged that noise is one component of what has been termed "input overload" for urban pedestrians (Milgram 1970). Pedestrians subjected to a level of environmental input (including noise) in excess of their capacity may adopt tactics to reduce this input to a tolerable level. When exposed to loud noise, pedestrians could have a range of reactions from walking faster to avoidance of very loud areas (Boles and Hayward 1978; Korte and Grant 1980). This concept is consistent with the City of Seattle noise ordinance, and the effects of noise as outlined in the FEIS. Construction noise will adversely affect residential or commercial areas within a few hundred feet of the heavy equipment. These effects would primarily come in the form of communication interference and sleep awakenings; however, heavy equipment noise could also contribute to "input overload" in pedestrians who may change their pace or overall route.

Noise effects on pedestrians would be more apparent in areas where, and at times when, pile driving was being conducted. Sheet pile driving would occur during the initial stages of construction in each zone, and would move from one end of the EBSP to another. Impact pile driving would be intermittent and at strategic locations along the EBSP. Pile driving would not remain in any one location for an extended period of time. Therefore, noise effects on the pedestrian environment would be minor.

3.3 NOISE IMPACTS OF WATER TREATMENT BARGE

As described in Chapter 2 of the DSEIS, the contractor may anchor barges offshore of Pier 62/63 to serve as construction staging areas. One of these barges could hold a number of tanks that would store and treat water pumped from behind the sheet pile containment wall before discharging it to Elliott Bay. In order to keep the area dewatered, pumps located on this barge would need to operate 24 hours per day, 7 days a week. Unlike other heavy construction equipment, these pumps may remain in the same location for the duration of EBSP construction rather than moving throughout the active construction area.

The noise generated by pumps on the barge would be loudest at the Seattle Aquarium, at the recreational area on Pier 62/63 and the adjacent sidewalk, and at the Waterfront Landings condominiums across Alaskan Way. Of these, the residents of the condominiums and the employees and animals at the Aquarium's new marine mammal exhibit would be exposed continuously to the noise while in the vicinity. Therefore, this analysis examined how sound attenuation or other noise reduction methods could be used to reduce the impacts of pump noise.

In general, the dewatering pumps and engines would dominate the noise-producing equipment associated with the dewatering activities. In addition, there may be other noise-producing activities and equipment on the barge. The dewatering operations would be audible to nearby residences and other noise sensitive areas. This would be true more so at night when background noises are more limited.

Based on the best available information, mitigation in the form of reductions by design (i.e., silencers, enclosures, and other engineering controls) would be required. These effects, which would potentially be significant, could occur with either sound-attenuated or non-attenuated pumps depending on how many and what types are chosen, and where they are ultimately located. For comparison purposes a discussion of both sound-attenuated and non-attenuated pumps and potential effects is outlined below.

A single off-the-shelf dewatering pump generates sound levels of 90 A-weighted decibels (dBA) at 30 feet similar to typical heavy equipment. There would be several pumps on the barge operating at the same time. When audible, the sound would be perceived as a steady hum or whine. If non-attenuated pumps were used and no sound control measures were taken, noise levels would be perceived as loud and possibly intrusive during all periods of the day and night. Pump noise would be clearly audible inside buildings even with their windows closed, particularly if the pumps were on the shore end of the water treatment barge. In addition, noise levels would be comparable at the adjacent Seattle Aquarium facilities and marine holding tank, and may be audible inside certain places within the facility itself. Pump noise would be loud throughout the recreational open space provided by Piers 62/63 during this period.

To reduce the noise levels associated with pumping, the City could specify the use of sound-attenuated pumps, which generate noise levels of between 65 and 70 dBA at 30 feet. Depending on the total number of pumps, their types, and location on the barge, sound-attenuated pumps may not be perceptible during the daytime, barely perceptible most of the night, but clearly audible during periods of quiet.

The Pier 62/63 location includes both nearby residential and commercial areas, and can be considered a reasonable upper-bound of effects. If the barge were located at different locations during construction, adjacent areas would experience similar types of effects as at Pier 62/63. However, if the barge moved closer to other commercial or residential areas, the noise at these areas could be greater than at Pier 62/63. Regardless of the ultimate location, care would be taken to ensure noise levels as measured at nearby areas fully comply with all federal, state, or local noise regulations, including the Seattle noise control regulation and the EBSP noise variance.

3.3.1 Mitigation

Because of the proximity to residences and the Aquarium, it is recommended that mitigation measures be implemented to reduce the impacts from noise. To ensure sound levels attributable to the proposed water treatment barge would be adequate to protect human health and welfare with an adequate margin of safety, the following measure is recommended:

- Design the water treatment system, through building and other equipment specifications (such as sound-attenuated pumps, silencers, mufflers, and engineered sound enclosures), to reduce noise levels as measured at nearby noise sensitive areas to fully comply with the thresholds outlined under all federal, state, or local noise regulations, including the Seattle noise control regulation and the EBSP noise variance.

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CHAPTER 4. OPERATIONAL EFFECTS

There is no change in operational effects since the FEIS.

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CHAPTER 5. REFERENCES

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