Chapter 3: Construction Activities

This chapter describes anticipated construction methods, activities, and sequencing for the Preferred Alternative and Options A, K, and L as analyzed in the SDEIS. Methods and activities are the same for all project designs, unless otherwise specified. Information in this chapter provides context for understanding the construction effects discussed in Chapter 6. Information in this chapter is presented at a level of detail intended to promote an understanding of methods that would be used to construct the new SR 520 corridor from I-5 to Medina. The following descriptions do not replace design guidelines and construction standards outlined and prescribed in WSDOT's manuals and specifications, and specific methods could change depending upon conditions or improving technologies. The construction durations, methods, and techniques described in this chapter will continue to be refined in design and construction of the project. Any refinements that result in additional or different effects will be analyzed as appropriate. Construction activities are also subject to various local, state, and federal agency permit requirements. However, the information in this chapter presents WSDOT's best current estimate of how, and in what sequence, the project would be built. Information from this section is based primarily on the Construction Techniques and Activities Discipline Report Addendum and Errata included in Attachment 7.

3.1 Where and when would construction occur?

Construction of the project would occur along the length of the SR 520 corridor between I-5 in Seattle and Evergreen Point Road in Medina. Construction would occur adjacent to the existing roadway and within WSDOT right-of-way to the greatest extent possible. Construction activities would take place on land, on work bridges constructed adjacent to the roadway, and from barges floating on the lake and outfitted with cranes. Construction would be sequenced to maintain traffic flow along the corridor; detour bridges would be constructed where roads cross SR 520 and along the main line, where needed.

Barges

Barges like these would be used to stage construction equipment and activities along the floating bridge.

Major construction activities along the corridor would be ongoing for approximately 7 years for the Preferred Alternative. This estimated time frame is based on the assumption that the project receives full funding and that construction would occur concurrently in multiple locations along the corridor. Within the overall construction period, areas of the corridor would be affected for varying amounts of time.

Construction time frames in the I-5 interchange area, Portage Bay Bridge area, and Evergreen Point Bridge area are similar for the Preferred Alternative and for Options A, K, and L. Construction in the I-5 area is estimated to occur over approximately 26 months, construction of the Portage Bay Bridge is estimated to take approximately 64 months, and replacement of the Evergreen Point Bridge would take approximately 45 months (including pontoon construction, east approach construction, and demolition of the existing bridge). Construction of the Montlake interchange is estimated to take between 56 and 60 months for the Preferred Alternative and Options A and L, and approximately 78 months for Option K. Construction of the west approach is estimated to take approximately 59 months for the Preferred Alternative and Options A and L, and approximately 70 months for Option K. Subsequent sections of this chapter provide more detailed descriptions of how long specific construction activities would take for each geographic area, and describe where activities or durations would differ between the Preferred Alternative and SDEIS options. The following text also provides updates to information presented in the SDEIS for Options A, K, and L.

Construction Staging Areas and Equipment

Construction crews

Construction along SR 520 would be staged from both land and water. Land-based construction staging areas (shown in Exhibit 3-1) would be used for delivery and storage of construction materials and equipment, contractor office and storage trailers, and employee parking. These areas would be fenced and located adjacent to areas where project construction is occurring. Construction staging areas would vary in size and may require grading or excavation to level the site and install drainage improvements, depending on site conditions. Temporary driveways would be established from staging areas to the roadway network.

Office trailers, placed on temporary foundations, would be connected to available utilities, including power, telephone, water, and sewer as needed. Connecting to these utilities may include installing poles for power lines and excavating trenches to place water and sewer pipelines. After construction is complete, staging areas would be restored and disconnected from any utilities.

Along the corridor, construction would occur within WSDOT right-of-way to the greatest extent possible. Construction areas within existing and expanded WSDOT right-of-way would be cleared of vegetation and any

Exhibit 3-1. Construction Staging Areas for Preferred Alternative and Options A, K, and L

buildings or structures in order to provide adequate work space. Temporary fencing would be installed around construction areas to separate construction zones from adjacent properties.

Temporary erosion and sediment control measures would be used to prevent runoff of untreated stormwater and sediment from staging areas into city stormwater or sewer facilities, nearby wetlands or water bodies, or adjacent properties. WSDOT would develop and implement a spill prevention control and countermeasures (SPCC) plan to prevent and minimize the potential for spills of hazardous materials and pollutants. Once construction is complete, all staging areas and remaining exposed soils would be stabilized, landscaped, or restored. Planting and restoration efforts would follow permit conditions and mitigation plans.

Roadway and bridge construction activities would require a variety of construction equipment. Types of equipment and their use are shown in Table 3-1. For certain activities, construction crews may also require more specialized equipment such as pile drivers, derrick barge cranes, dewatering pumps and tanks, and conveyor belts.

Table 3-1. Typical Construction Equipment

Equipment	Typical Use
Air compressor	Pneumatic tool power and general maintenance
Backhoe	General construction
Concrete pump	Concrete pumping
Concrete saw	Concrete removal, utilities access
Crane	Materials handling, removal, and replacement
Excavator	General construction and materials handling
Forklift	Staging area work and hauling materials
Generator	General construction work
Haul truck	Materials handling, general hauling
Jackhammer	Pavement removal
Loader	General construction and materials handling
Paver	Roadway paving
Pile driver	Support-installation for structures and hillsides
Pump	General construction use, water removal
Pneumatic tools	Miscellaneous construction work
Service truck	Repair and maintenance of equipment
Tractor trailer	Material removal and delivery
Utility truck	General project work
Vibratory equipment	Activities to shore up hillside or install piles

Construction Using Barges and Tug Boats

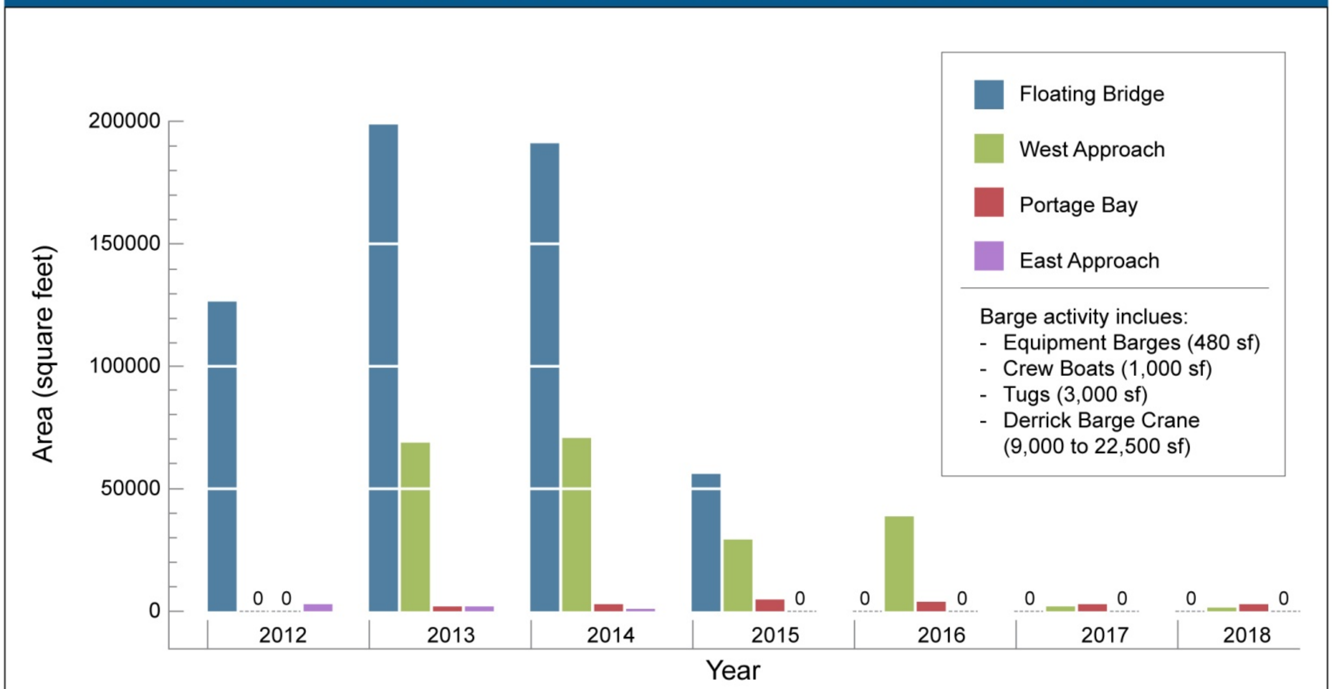
Barges would be used to stage construction materials, store construction equipment, transport demolition debris, provide a work area for construction personnel, and store water containment systems and water

storage tanks. Barges would be used to construct the superstructure on top of pontoons for the new floating bridge, and would be used to construct the columns and bridge spans for the east and west transition spans to the new floating bridge. The far eastern portion of the new west approach would also be constructed from barges. Barges could also be placed below a proposed demolition activity to collect demolition debris. Construction materials such as anchors, piles, timber decking, concrete, structural steel, and precast concrete units could be transported to the construction site by way of barges and tug boats.

The superstructure for the new bascule bridge would likely be transported to the site by barges and tug boats. Once the tug boats are situated in the Montlake Cut, barge-mounted derricks would lift and hold bridge sections in place during installation. Additionally, barges could be used in place of tugs to transport floating bridge anchors and pontoons from upland concrete casting sites to Lake Washington.

Barges would range in size from 12 feet by 40 feet for smaller materials vessels, to 75 feet by 300 feet for crane-mounted barges. Tug boats would be used to maneuver barges and pontoons into and around Lake Washington. Tug boats and crew boats can range in size from 20 feet by 50 feet to 30 feet by 100 feet. Peak barge use would occur during the first 3 years of floating bridge assembly on Lake Washington, and as many as 25 barges could be in use on the lake at one time. Barges would also be used to support construction activities in Portage Bay and for the west approach to the floating bridge. Exhibit 3-2 shows the maximum estimated barge activity for construction of the SR 520, I-5 to Medina project.

Exhibit 3-2. **Maximum Estimated Barge Activity for the Preferred Alternative and Options A, K, and L**



Materials Transport and Haul Routes

Materials would be also transported to and from the construction sites by trucks. Trucks would travel over identified haul routes through Seattle and Medina to SR 520, I-5, and I-405. Construction assumptions developed for the project identify major freeways as primary haul routes intended to carry most project truck traffic. However, there will be times when city streets will need to be used as secondary haul routes. Secondary haul routes for the SR 520, I-5 to Medina project were identified based on criteria such as shortest off-highway mileage, and providing access to locations needed for construction where direct highway access is unavailable.

Potential haul routes identified for material transport, road closures, and estimated truck trips are discussed in the following paragraphs. These routes include both local and regional roadways. Since publication of the SDEIS, WSDOT has refined potential haul routes to avoid using non-arterial neighborhood streets. Local jurisdictions can limit the use of non-arterial streets for truck traffic; therefore, efforts were made to identify designated arterial streets for potential use as haul routes. Local jurisdictions will determine final haul routes for those actions and activities that require a street use or other jurisdictional permit. The permit process typically takes place during the final design phase and prior to construction. Exhibit 3-3 shows the potential primary and secondary truck haul routes evaluated for the Preferred Alternative and SDEIS Options. Most haul route traffic would be on I-5 and SR 520. These main routes would be more efficient for contractors to access work sites. Whenever possible, crews would work from WSDOT right-of-way or build temporary direct-access connections to work sites and staging areas from SR 520.

For analysis purposes, the project assumed all construction spoils would be removed from the project site by truck. This would represent worst-case conditions for truck traffic. Barges may be used to remove spoils if determined to be practicable. Barges are expected to be used to transport materials and demolition debris to and from the project area.

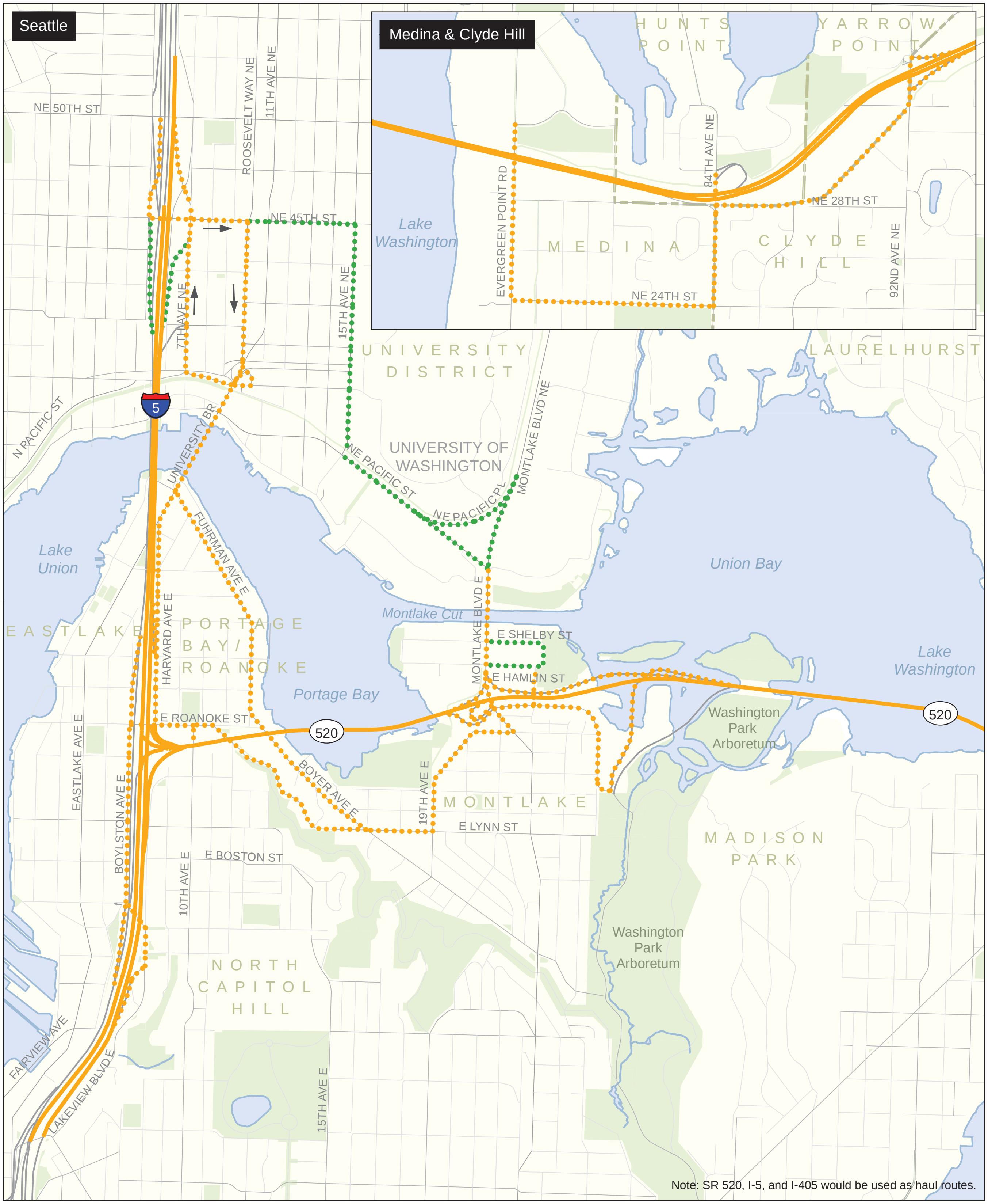
The Preferred Alternative, and Options A, K, and L would require using many of the same haul routes. Potential roadways include:

- SR 520
- I-5
- I-405
- Fuhrman Avenue East
- Boyer Avenue East
- East Roanoke Street
- Delmar Drive East
- Harvard Avenue East
- Boylston Avenue East
- East Lynn Street
- Montlake Boulevard
- NE 45th Street
- NE 24th Street (Medina)

Construction Effects on Traffic

Effects on traffic resulting from project construction, including haul routes and road closures, are discussed in Section 6.1 under the heading *How would construction affect traffic operations?*

Exhibit 3-3. Potential Haul Routes for Preferred Alternative and Options A, K, and L



Potential primary haul route (Preferred Alternative and Options A, K, and L)

Potential secondary haul route (Preferred Alternative and Options A, K, and L)

Potential secondary haul route (Options K and L)

N 0 1,000 2,000 Feet

- Points Drive NE
- 84th Avenue NE
- 92nd Avenue NE

Since publication of the SDEIS, WSDOT made further refinements to some potential haul routes, resulting in removing some haul routes from consideration, and adding others. For instance, the southern leg of Boyer Avenue East (south of East Lynn Street) is not identified for hauling activities in this Final Environmental Impact Statement (EIS) analysis. East Shelby and East Hamlin streets would likely be needed to support tunnel construction activities for Option K, while NE Pacific Street and 15th Avenue NE would be needed to support the new depressed interchange at Montlake and NE Pacific Street under Options K and L. A more detailed discussion of haul routes and related effects can be found in Chapter 6.

Potential haul routes for construction of the east approach bridge and bridge maintenance facility would include SR 520 and potentially Evergreen Point Road and 92nd Avenue NE.

Construction zone access would be provided from temporary driveways and direct access ramps. Temporary driveways would be constructed between the staging areas and the roadway network. These access points would link with the haul routes and be monitored by flaggers, law enforcement, or construction workers, depending on the location. A construction access ramp may be provided directly into the construction zone from the SR 520 westbound Montlake off-ramp, and SR 520 westbound Montlake on-ramp pending further coordination with NOAA. Outbound trucks could also re-enter the Montlake westbound off-ramp near the intersection with Montlake Boulevard. These trucks could either go straight to access the SR 520 westbound on-ramp or turn left and travel to the SR 520 eastbound on-ramp to reach their final destinations.

Peak construction activities (including concrete pours or excavation and fill) would involve the highest numbers of workers, materials, and equipment, and more trucks would use regional and local roadways. In order to meet the current schedule, it was conservatively assumed that during the peak construction activity, peak truck-haul activity would occur simultaneously for different project components, including the Portage Bay Bridge, the Montlake interchange, and the west approach bridge.

Table 3-2 summarizes the potential number of haul route trips on SR 520, I-5, and I-405 during peak construction (per day for each option). As previously indicated, project construction assumptions developed are intended to keep the majority of haul route traffic on major freeways such as I-5, SR 520, and I-405.

Roadway and Ramp Closures

During weekday peak travel, WSDOT would maintain two through lanes on SR 520 in each direction. In addition, the on- and off-ramps at Montlake Boulevard would remain open or temporary ramp connections would be constructed. Most lane and ramp closures required during construction would occur at night and on weekends for limited periods of time. Roadway closure hours and dates would be timed to avoid special events and would be coordinated with closures on other freeways.

Table 3-2. Estimated Number of Peak Construction Period Haul Route Trips on Local Highways

Regional Freeway[a]	Per Day		
	Preferred Alternative and Option A	Option K[b]	Option L
SR 520	590	620	420
I-5	340	400	300
I-405	240	320	220

[a]No effects are expected on I-90.
[b]The hauling of material out of the single-point urban interchange and tunnel (Option K) would typically occur for 10 hours per day, and occasionally for up to 16 hours per day.

As project construction progresses, the road closures and traffic detours would change to best accommodate construction needs and to minimize traffic congestion. Detour routes would be determined both during project permitting and as part of ongoing construction management activities. Currently, project construction schedules assume that when portions of SR 520 need to be closed for construction activities, closures would occur at night (between the hours of 9 p.m. and 5 a.m.) and on weekends.

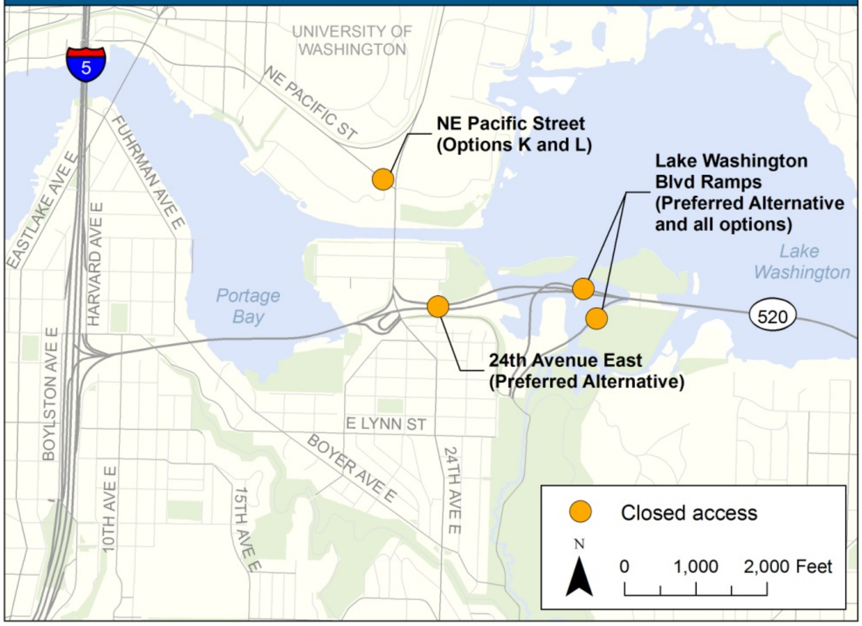
Some local street use may be limited for short durations during construction. Temporary road closures necessary for certain construction activities are likely to result in inconvenient driving conditions and traffic congestion. In addition, direct access to and from some buildings may be disrupted, though not eliminated, for short periods of time. Reductions in access would occur mainly at night and during off-peak hours. Construction of the Preferred Alternative would require at least one temporary roadway closure lasting approximately one year (Exhibit 3-4). New construction sequencing developed since publication of the SDEIS has eliminated the need for the 9-month-long closure at Delmar Drive described for Options A, K, and L. These closures and detours are summarized below. See the Transportation section in Chapter 6 (Section 6.1) for a discussion of how traffic would be affected by construction.

Road Closures

The temporary closure of portions of SR 520 and its ramps would be required periodically for certain construction activities. An example of a construction activity that would require lane closures is placement of precast girders for the new lids over SR 520.

The only permanent road closures identified for the SR 520, I-5 to Medina project are the Lake Washington Boulevard ramps.

Exhibit 3-4. **Road Closures for Preferred Alternative and Options A, K, and L**



Delmar Drive East

For the SDEIS analysis, Delmar Drive East was assumed to be closed temporarily for 9 months under Options A, K, and L to accommodate construction on SR 520, as well as construction of the 10th Avenue and Delmar Drive East lid. The design and the new construction sequencing developed for the Preferred Alternative have eliminated the need for this closure. Instead, traffic on Delmar Drive East crossing over SR 520 would be diverted to a temporary detour on the new lid structure during construction. Staged construction of the 10th and Delmar lid would allow maintenance of traffic on both 10th Avenue East and Delmar Drive East for the duration of construction. This closure refinement could also apply to Options A, K, and L.

Pacific Street

For Options K and L, the portion of Pacific Street from Montlake Boulevard to just west of the University of Washington Medical Center access driveway would be closed for 9 to 12 months to accommodate the lowering of the Pacific Street/Montlake Boulevard intersection and providing a lid in this area. The Preferred Alternative design does not include a lid or grade change at this intersection; therefore, construction of the Preferred Alternative would not require closing Pacific Street.

24th Avenue East

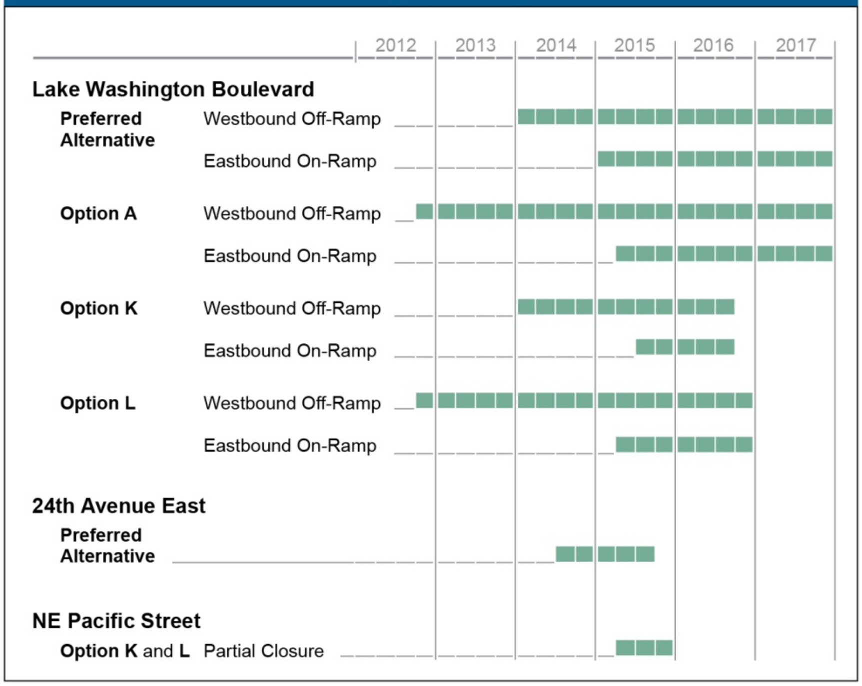
There would be one long-term, temporary road closure during construction of the Preferred Alternative. The 24th Avenue East bridge across SR 520 north of Lake Washington Boulevard would be closed to all traffic for approximately one year while the bridge is demolished and reconstructed. The new 24th Avenue East bridge would be constructed and opened in conjunction with the new westbound off-ramp to Montlake Boulevard, prior to completion of the Montlake lid. Once completed, this new bridge would accommodate SR 520 traffic exiting to Lake Washington Boulevard.

Work Bridge

Lake Washington Boulevard Ramps

Construction of the Preferred Alternative would close the Lake Washington Boulevard ramps to make room for the construction work bridges and the new west approach structure. This closure would be permanent, and ultimately, SR 520 traffic moving to and from Lake Washington Boulevard would have access at the new Montlake interchange via 24th Avenue, located on the new lid (Exhibit 3-5).

Exhibit 3-5. **Durations for Roadway and Ramp Closures**



Before closing the Lake Washington Boulevard ramps, a number of capacity improvements would be made to the existing Montlake Boulevard interchange to accommodate additional traffic (see Section 6.1 for traffic volume details). During the first year the Lake Washington Boulevard ramps are closed for construction, traffic would be detoured to Montlake Boulevard. Once construction of the 24th Avenue East bridge is complete, traffic would be able to access Lake Washington Boulevard via 24th Avenue East or Montlake Boulevard.

In-Water Construction

In-water work requires specific permits from several resource agencies. These permits, which are separate from the National Environmental Policy Act (NEPA) process, specify constraints and guidelines to minimize construction effects on fish and aquatic habitat. Design considerations for in-water construction activities include the location and configuration of permanent and temporary in-water structures, the timing of construction (i.e., appropriate in-water work windows), and measures to protect water quality.

In-water construction activities would occur in Portage Bay, Union Bay, and Lake Washington (Exhibit 3-6).

> DEFINITION
>
> **What is an in-water work window?**
>
> Work windows are time periods specified by natural resource agencies for conducting work in streams, lakes, and rivers. The periods are selected to minimize harm to fish and other aquatic resources. For example, work windows in Lake Washington were established by the Washington Department of Fish and Wildlife (WDFW) to minimize construction effects on salmon during critical times of the year, such as when the salmon are spawning or migrating.

Exhibit 3-6. **Area and Types of In-Water and Over-Water Work**

Construction Activity or Method[a]	Portage Bay Area	Mont-lake Area	West Approach Area	Floating Bridge Area and East Approach Area	Eastside Transition Area
Pontoon towing	🟢	🟢	🟢	🟢	
Anchor installation				🔴	
Pontoon assembly and disassembly				🟢	
Bridge superstructure outfitting				🟢	
Work bridge construction and removal	🔴		🔴	🔴	
Cofferdam or sheetpile installation and removal	🔴		🔴	🔴	
Drilled shafts	🔴		🔴	🔴	
Mudline footings	🟢				
Cast-in-place girder superstructure	🔴			🔴	
Existing bridge removal	🔴		🔴	🔴	
Tunneling (Option K)		🟢			
Bascule bridge (Preferred Alternative and Options A and L)		🟢			

🟢 No in-water work restrictions
🔴 In-water work restrictions apply

[a] Construction methods identified for the Portage Bay, west approach, and east approach locations cover a range of methods that could be used for construction of the Preferred Alternative and SDEIS options.

Examples of in-water construction activities include the following:

- Work bridge construction and removal
- Drilled shafts and bridge foundations construction
- Cofferdam construction and removal
- Existing bridge demolition
- Stormwater outfall construction
- Floating bridge anchor system installation

Cofferdam

The photo above is an example of a cofferdam. Cofferdams provide a dry work area when construction takes place within a water body.

To minimize effects on fisheries and other natural resources, in-water construction would be limited by permit conditions to the approved work windows. WSDOT continues to work with natural resource agencies through the Natural Resource Technical Working Group to define in-water work windows specific to the project area and activities. Table 3-3 identifies the current in-water work windows established by the Washington State Department of Fish and Wildlife (WDFW) for the Lake Washington Ship Canal and for Lake Washington. Actual work windows for these areas will be defined by WDFW in cooperation with the U.S. Fish and Wildlife Service and National Marine Fisheries Service as conditions presented in the Biological Opinion (Attachment 18) and the Hydraulic Project Approval, prior to construction.

Table 3-3. In-Water Work Windows

Area	WDFW-Published Work Window[a]	WSDOT-Proposed Work Window
Portage Bay	October 1 to April 15	August 16 – April 30
Union Bay	July 16 to March 15	September 1 to April 30 (impact pile-driving only)
Lake Washington (west approach area)	July 16 to March 15 (north of SR 520) July 16 to April 30 (south of SR 520)	August 1 to April 30
Lake Washington (east approach area)	July 16 to March 15 (north of SR 520) July 16 to April 30 (south of SR 520)	July 1 to May 15

[a] WSDOT is working with resource agencies to define project specific work windows based on construction activities, duration of construction, and schedule. Any deviations from the WDFW published work windows are defined in the project Biological Opinions issued by the USFWS and NOAA Fisheries, and will also be identified in the HPA issued by WDFW.

In addition to defining in-water work windows, resource agencies place other types of conditions on their permits to protect aquatic species and habitat. Conditions for the SR 520 project will include requirements that WSDOT apply specified best management practices to prevent construction activities from exceeding state water quality standards. Noise attenuation measures will also be required to reduce the effects of in-water pile-driving on fish and other aquatic species. Chapter 6 contains more detailed information on potential best management practices (BMPs) to minimize effects, on potential noise attenuation measures, and on other forms of construction mitigation.

Demolition would be required for those fixed structures over water that will be replaced by new structures as well as the existing floating bridge. This type of demolition would require impact hammers and other equipment to remove all features of the existing structures (traffic barriers, bridge deck, pier caps, columns, etc.), as well as saw and torch cutting to cut the bridge deck into manageable sections that can be lifted by a crane.

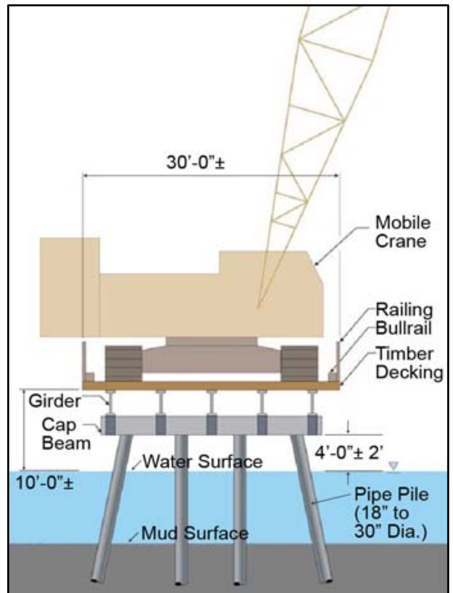
Pieces of the roadway would be loaded by crane onto trucks or barges for disposal or recycling. Columns and piles would be removed (using vibratory extraction where possible and necessary), or cut 2 feet below the mudline (ground surface).

Over-water demolition requires special precautions and equipment to prevent debris or concrete-laden water from entering the natural water system. Nets, tarps, platforms, scaffolds, blankets, barges, and floats can be used to contain the debris; vacuums, diverters, absorption materials, holding tanks, and drainage systems can be used to contain concrete-contaminated water.

Work Bridges and Falsework

Construction work bridges would be built in four general areas along the project alignment: Portage Bay, Union Bay, the west approach in Lake Washington, and the east approach in Lake Washington (Table 3-4). Work bridges are proposed in shallow-water areas where work from barges is not possible. Each of these shallow-water areas is expected to need two construction work bridges, one on either side (north and south) of the new alignment. Work bridges are expected to also be used for demolition purposes. There will be periods when both the north and south work bridges are functional, depending on construction requirements. The typical layout of a construction work bridge consists of about a 30-foot-wide structure, with heavy timber decking supported by steel beams (see Work Bridges sidebar). Work bridges would be built on driven piles installed from a mobile crane.

Construction of work bridges would be accomplished from a crane that starts out on land behind a temporary wall on a pad prepared at the edge of the water. The crane swings out and starts driving piles in the water for the first pile bent. Pile installation for work bridges would be conducted using a combination of vibratory and impact pile-driving (a single crane can be fitted with either a vibratory or impact hammer, depending on the need). After all piles for each bent are driven, they are cut off at the same elevation. Steel cap beams are set on top of the piles to complete the bent. Support beams are welded from one bent to the next and timber deck panels are then bolted to the support beams. After the deck span is in place,



Work Bridges

The diagram above is an example of a work bridge. Similar work bridges would be used in Portage Bay and for construction of the west and east approach structures. These bridges would be approximately 30 feet wide and approximately 5 to 10 feet above the high water elevation.

DEFINITION

Pile Bent

A pile bent is an engineering term that refers to a row of piles that are fastened together. The row of piles together provides a framework for carrying the bridge deck.

the crane is advanced out onto the span and the operation continues until all the bents and work bridge spans are in place.

Table 3-4. Work Bridge Elements by Area - Preferred Alternative

	Portage Bay	West Approach	East Approach
Number of piles	1,300	2,100	165
Area of work bridge (square feet)	261,900	703,400	42,000
Duration of pile-driving[a]	14 non-consecutive months	16 non-consecutive months	5 months
Work bridge duration	64 months	58 months	36 months

[a] Duration of pile-driving is the total number of months that pile-driving could occur during the full duration of construction. For instance, if construction is expected to last 64 months in Portage Bay, pile-driving could occur for as many as 14 months, non-consecutively, during that 64-month construction period.

Falsework (see Falsework sidebar) is a temporary structure that supports permanent bridge structures during construction. It carries the weight of the permanent structure until the permanent structure is capable of supporting its own weight. For example, falsework often supports cast-in-place concrete formwork that holds the freshly placed concrete of a bridge deck. After the concrete of the major structural elements has hardened and attained sufficient strength for the bridge to support its own weight, the formwork and falsework can be removed. Falsework generally consists of steel pipe and/or timber columns, piles, beams, and bracing elements or scaffolding to support the plywood and lumber formwork.

Permanent Bridge Construction

Information in this, and subsequent sections is presented at a level of detail intended to promote an understanding of typical methods that could be used to construct project elements such as roads and bridges. The actual methods used to construct the corridor may vary depending on corridor conditions and available technologies. Any refinements that result in additional or different effects will be analyzed as appropriate. Effects resulting from the construction techniques described in this chapter are presented in Chapter 6, Effects During Construction of the Project.

Drilled Shafts

The permanent portions of the proposed bridges would be supported by reinforced-concrete drilled shaft foundations. Possible equipment to be used for drilled shaft construction is as follows: vibratory pile-driving hammer, crane-mounted rotator/oscillator, crane-mounted drill auger, crane-mounted rock drill, excavator grab bucket, front-end loader, concrete tremie, concrete pump truck, ready-mix concrete trucks, concrete vibrators,

DEFINITION

Falsework

Falsework is a structure built to hold precast bridge sections or forms for concrete in the correct place. The photo in the pile bent sidebar shows falsework supporting a freshly placed concrete bridge deck. Falsework remains in place until the permanent structure is capable of supporting its own weight.

Drilled Shaft Casing

The photo above shows how a drilled shaft casing is installed. The pipe is first lowered by crane to the substrate and vibrated into position. After the casing is installed, a crane lowers the auger and begins to drill into the substrate, stopping and lifting the auger periodically to pull the substrate out of the hole and deposit it on the work bridge.

cross sonic logging testing equipment, pumps, and holding tanks. Typical drilled shafts for this project would be between 6 and 12 feet in diameter and drilled with an auger.

In-water drilled shaft construction activities would be staged from land, work bridges, or barges, typically using a casing pipe. This pipe would be lowered by crane to the substrate and vibrated (see Drilled Shaft Casing sidebar) deep enough to prevent hole cave-in and maintain the top of the casing above the waterline. After the casing has been installed, a crane would lower the auger and begin to drill into the substrate/soil material, stopping and lifting the auger periodically to pull the substrate/soil out of the hole and deposit it on the land, work bridge, or barge.

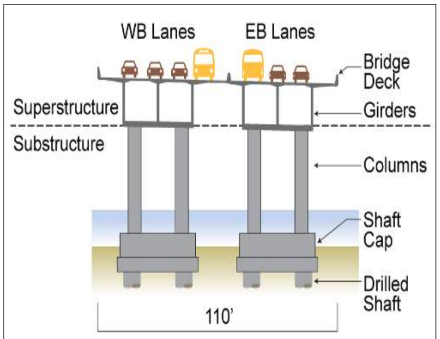
After the shaft excavation is completed, a prefabricated reinforcing steel shaft cage is lowered into the excavation and concrete is pumped into the casing, displacing the water or slurry. The water or slurry would be contained, collected, and treated prior to reuse or disposal. During the concrete placement, the casing pipe may be gradually extracted but would remain at least partially in place to form the top of the shaft.

Bridge Columns/Piers and Shaft Caps

Concrete columns extend from the top of the drilled shaft or shaft cap, and connect the bridge deck and girders to the foundation (e.g., drilled shaft) below (see Substructure and Superstructure sidebar). In situations where the bridge is low and close to the water surface, the columns would extend through the entire water column directly to the top of the shaft (located at or below the mudline).

In-water work to install the columns would be accomplished inside the large-diameter drilled-shaft casing (see previous section) or cofferdam to isolate the work from the open water. Cofferdams are generally constructed with steel sheet-piling vibrated into the mud with a vibratory hammer, typically to 20 feet below the bottom of the excavation. Water is then pumped out of the area within the cofferdam to provide a dry working environment. The casings or cofferdams allow construction access below the waterline to install the column-reinforcing steel and column formwork needed to pour the concrete column in dry conditions. Columns would be constructed from work bridges or barges. Construction activities, equipment, and BMPs used will be similar to those described above for the drilled shafts.

When more than one drilled shaft per column is required to support the bridge load at a given pier, a shaft cap (also called a "footing") would be constructed. A shaft cap would tie the multiple shafts together and spread the load from the column(s). Multiple drilled shafts and shaft caps are generally needed when soil conditions are poor and a bridge has long spans.



Substructure and Superstructure

A bridge consists of two major parts: a substructure and a superstructure. The substructure includes the bridge foundation and support structures. For Portage Bay, this would include the drilled shafts, shaft caps, and support columns. The superstructure is the part of the bridge above the columns. For Portage Bay, this would include the girders and the roadway slab.

The support column would be constructed on top of the shaft cap. Concrete shaft caps are constructed at the top of shafts using formwork, reinforcing steel, and poured concrete footings. The columns are constructed by building a wire "cage" of reinforcing steel on top of the footings; forms for the concrete columns are constructed around the wire cage, and concrete is poured into the forms. In-water columns can be constructed within cofferdams or installed from barges or work bridges.

Bridge columns along the corridor would be typically either round or rectangular in shape. The final shape of the column may be modified to better serve load-bearing requirements or aesthetic goals.

Superstructure

The bridge superstructure (girders and bridge deck) would be constructed on top of a group of columns, called a pier. Parts of the superstructure may be prefabricated (or precast) and hauled into place using barges, trucks, and/or cranes, or may be constructed from raw materials directly on the pier (called cast-in-place). As previously described, cast-in-place bridge elements typically require some falsework to support the structures while they are being constructed. After the concrete has cured and achieved adequate strength, the forms and falsework would be removed. Construction for the superstructure would take place from work bridges, barges, and, in some cases, the old bridge deck as well.

Bridge spans constructed from precast or prefabricated girders would be constructed by lifting girders into place by a crane, and then the bridge deck (roadway) and other design elements like traffic barriers and noise walls, if included, would be constructed on top of the girders. Roadway deck forms would be supported by the girders, and would support the reinforcing steel and fresh concrete for the concrete roadway deck. After the roadway concrete has cured and achieved adequate strength, the forms would be removed.

Cast-in-place concrete box girder construction would be used for some of the Portage Bay and east approach structures. For cast-in-place construction, falsework is constructed first, directly under and adjacent to the bridge area. Forms for the girders and deck are placed on top of the falsework, reinforcing steel is installed inside the forms, and concrete is poured.

Bascule Bridge

The Preferred Alternative (like Option A) includes a new bascule bridge over the Montlake Cut constructed to the east of the existing bridge. A bascule bridge is a movable bridge with counterweights on either end that balance the leaves (or spans) throughout their upward swing. Hydraulic or gear mechanical systems are used to operate the bridge. When open, the bridge provides unlimited vertical clearance for boat traffic. The existing Montlake and University bridges are examples of bascule bridges.

Most construction activities for the bascule bridge would be staged from land near the shoreline (upland); however, derrick barges would also be temporarily positioned in the Montlake Cut. Barges would be anchored in place using spud anchors (oversized nail dropped into place) at the corners of the barge or with the assistance of tug boats. The upland work would consist of constructing pier supports, which would form the foundation for the bascule bridge. After the pier supports are completed, the bascule-leaf steel members (drawspan bridge deck) would be assembled piece by piece onsite, or the entire leaf may be assembled offsite, barged to the project area, and erected with several derrick cranes. In either case, a barge-mounted derrick crane situated in the Montlake Cut would lift the bridge sections into position while they are attached to the upland piers.

These activities would likely require periodically closing the Montlake Cut to boat traffic. A total of six closures may be necessary over a 3- to 4-week period, typically only while barges are anchored for bascule leaf construction. Barges would be moored in the cut for less than 48 hours at a time to support lifting the bascule leaf spans into place. If final design yields a concrete bridge deck for the bascule bridge, the Montlake Cut could be partially closed to over-height marine traffic during the over-water construction period because the new bridge deck would be poured in two separate events. Construction staging of the bridge deck would leave one bridge leaf open while the other half is poured and cured. The construction barges would likely be anchored in the Montlake Cut only during actual bridge assembly work. Based on these closure requirements, this work would be scheduled for periods of low use by boat traffic.

Bridge Demolition and Disposal

Construction of the SR 520, I-5 to Medina project would require extensive demolition and removal of over-water and in-water structures. Demolition is defined as major breaking, crushing, and cutting of existing structures for eventual disposal; it may include salvage of reusable or recyclable materials. In the context of the project, removal is defined as vibrating, pulling, and dismantling existing structures for eventual disposal, reuse, or recycling.

The Preferred Alternative would result in an estimated 1.95 million cubic yards of demolition debris. This would include demolition for existing structures as well as temporary widening and temporary roadway and bridge connections.

The following represents a typical demolition sequence for an existing and permanent bridge or ramp:

Bridge Demolition

The photo above shows over-water demolition, which requires special precautions and equipment to prevent debris or concrete-laden water from entering the natural water system.

See Chapter 6 for a discussion of the construction effects of demolition activities.

- **Step 1:** Deploy containment BMPs to prevent any demolition materials from entering the water. This step would also include debris containment and demolition water containment.
- **Step 2:** Demolish the traffic barriers and rails. Concrete traffic barriers likely would be demolished with an impact hammer (i.e., jack-hammer or excavator attachment) or a combination of saw cutting and impact removal.
- **Step 3:** Remove the superstructure and crossbeams by saw cutting and using an impact hammer. The concrete bridge deck would be cut and any temporary support elements such as diaphragms or bracing walls would be removed to allow the girders to be lifted. After the deck is cut, the pieces would be removed, one at a time, loaded onto trucks or barges, and then hauled or shipped for offsite demolition.
- **Step 4:** Remove the entire column/pile by vibratory extraction. This method involves attaching a vibratory hammer and a hook from a crane to the top of the column, and simultaneously vibrating and lifting the column. Should this method prove to be ineffective, the column would be cut 2 feet below the mudline by divers using an underwater diamond wire saw. At that point, the columns would be loaded onto a barge for disposal or recycling.
- **Step 5:** Fill any holes or depressions in the substrate caused by the substructure removal process with native material or other material approved by the environmental permits.

Demolition of the existing approach structures and floating bridge would consist of similar steps as those described above for the permanent bridges and would include the following actions:

- Transition span removal
- Elevated floating bridge superstructure removal
- Pontoon removal
- Anchor cable removal and decommissioning
- Approach structure removal

Transition Spans

Two truss structures currently serve as transition spans and link the floating structure to the fixed approach structures on each end of the floating bridge. Demolition would likely be performed by removing each truss structure in one piece, either by using floating cranes to lift the truss off its bearings or by positioning a barge under each transition span and using jacks to lift each truss vertically off its bearings.

The Ballard Locks have a width limit of about 79 feet. The availability of floating cranes that would fit through the locks and also have the capacity to lift an entire transition span could be limited. Because of this, it may be necessary to remove the roadway deck and barriers to reduce weight before removing the steel truss structure in one piece.

Floating Bridge Elevated Superstructure

The extent of elevated superstructure removal from the pontoons would likely be dictated by the destination of individual pontoons after leaving Lake Washington. For pontoons that may be towed in the open ocean, the road deck and columns that rest on some of the pontoons may need to be removed to maintain pontoon stability while under tow. Demolition of the elevated superstructure and columns would be the same as that described for fixed bridges, except that columns would be cut flush with the top of the pontoons. For pontoons that are not towed in the open ocean, much of the elevated superstructure could remain in place until they leave Lake Washington. Options for pontoon disposal are discussed below.

Pontoon Disassembly and Removal

Pontoon disassembly and removal consists of saw-cutting the pontoon joints, disconnecting pontoons from their anchor cables, and towing them away. Some, or all, of the roadway that rests on the pontoons may need to be removed before the pontoons are transported out of Lake Washington.

Anchor and Anchor Cable Removal

Typically, anchor cable removal consists of detaching anchor cables at their connections to the pontoons and anchors, then winding the cables onto spools on barges for transport. Floating cranes would be used to wind the cable onto spools. Divers would detach the anchor cables from the anchors.

The existing floating bridge has three types of anchors: concrete fluke anchors, rock-filled concrete gravity anchors, and pile anchors. Underwater anchor decommissioning consists of abandoning all fluke and gravity anchors in place. If practicable, pile anchors would be removed to the mudline (ground surface) or abandoned in place.

Disposal

Trucks, barges, and tugs would be used to transport materials from demolition and construction sites along SR 520. Barges and tugs would transport a large portion of the material through the Montlake Cut and the Ballard Locks to disposal sites or transfer facilities accessible by water. Due to the large amount of disposal material and the transport required by land and water, multiple disposal sites would likely be used.

Materials disposal would occur at approved disposal sites. Demolition materials would be disposed of in accordance with federal, state, and local laws and ordinances. Demolished concrete pieces could also be transported to local concrete recycling facilities.

As with past WSDOT floating bridge projects, all pontoons, including the elevated superstructure in the existing floating bridge, could be made available for purchase. All existing pontoons, including the elevated superstructure, that were removed as part of the recent Hood Canal Bridge project were sold to private parties. Pontoons could be reused for a wide variety of waterfront functions such as docks, breakwaters, and dolphins. If pontoons are not sold, they would be towed to an approved site, such as a graving dock or floating dry dock, and demolished. WSDOT would not sink any pontoons in any water body as a disposal method.

3.2 What are the construction activities and sequencing for the Preferred Alternative?

The following subsections describe the general nature and sequence of construction activities in each area of the SR 520 corridor. Because the project is at a preliminary level of design, project details and construction methods have not been fully defined and may change somewhat as the design evolves. In addition, construction contractors typically have many choices about construction methods to be used. However, the descriptions below provide a reasonable assessment of how the project would be constructed and provide a baseline for understanding the types of effects that would result from construction activities.

Site Preparation

The first step in construction would be preparation of staging and construction areas. As part of this work, temporary erosion and sediment control (TESC) measures and temporary drainage structures would be installed to prevent run-off of untreated stormwater and sediment from entering city stormwater or sewer facilities, nearby water bodies, or adjacent properties. A variety of temporary construction BMPs could be used, including silt fences, berms, storm drain inlet protection, straw bale barriers, and detention or siltation ponds.

Temporary Fencing

Example of fencing to protect a wetland during construction.

Specialized BMPs are needed around concrete-handling areas to prevent water contaminated by uncured cement from entering water bodies or stormwater treatment facilities. Conveyance systems for the movement of stormwater from a collection point to an outfall can consist of drainage pipes and retention facilities (such as ponds, vaults, and catch basins) and can use gravity or pumps to move the stormwater. Staging areas are often equipped with wheel washes that clean truck tires to reduce tracking of dirt and dust offsite.

Temporary fencing would be installed around construction areas to prevent machinery and equipment, materials storage, and construction activity from intruding into adjacent properties, wetland and stream buffers, and shoreline areas. Staging and right-of-way construction areas would be cleared of any unneeded structures and vegetation to provide adequate