Summary of Tiered Conservation Hypotheses

ID	Targeted River Miles (RM)	Draft Conservation Hypothesis	Example Actions	Related Conservation Hypotheses	Lifestages Targeted	Targeted Functions	VSP Parameters Addressed	Key Assumptions	Data/ References	Habitat Management Strategy Type / Relative Certainty1
Tier 1										
All-2	---	Protecting and improving riparian conditions by adding native riparian vegetation will enhance habitat quality by improving water quality, stabilizing streambanks, providing overhanging vegetation and large woody debris (LWD), and contributing organic matter, nutrients, and terrestrial prey items, thereby leading to greater juvenile salmon growth and higher survival.	• Restore native vegetation in marine and freshwater riparian areas to provide shade, reduce runoff rates, and reduce contaminants entering waterways with functional buffers • Restore native vegetation in riparian corridor that improves water quality and contributes organic matter and terrestrial prey items • Reconfigure levees and bulkheads, particularly in the Lower Green River and marine shorelines, to allow restoration of riparian vegetation in more natural proximity to water to improve likelihood of vegetation survival and functional contribution to salmon habitat • Add overhanging vegetation • Plant riparian vegetation to improve long term potential for LWD recruitment • Provide riparian vegetated buffers • Remove/prevent armoring and fill • Maintain or restore riparian corridor conditions in tributaries • Add LWD in mainstem river and tributaries to provide habitat complexity, organic matter, and high-energy refuges	• All-1	• Juvenile foraging/rearing • Juvenile migration • Adult holding • Adult spawning	• Increase food availability • Improve predator refuge • Expand physiological refugia • Expand high energy/flow refugia • Enhance migration corridor • Enhance rearing habitat • Improve spawning ground quality for salmonids as well as forage fish in nearshore areas • Pollution abatement • Soil stability • Erosion control • Wildlife habitat • Organic/nutrient inputs • LWD inputs/habitat structure • Microclimate • Prey production	• Abundance • Productivity	• Improved riparian conditions will enhance prey availability • LWD recruitment will enhance pool and spawning habitat • Enhanced prey availability will enhance growth and survival • Juvenile salmon will use shade of improved riparian corridor and eventually LWD provided from riparian vegetation will provide refuge from fish and bird predators • Forage fish egg survival is higher on shaded beaches • Salmon utilization of tributaries will increase with improved conditions	• Brennan and Higgins (2004) • City of Seattle Marine fish report 2004 • Penttila 1998. • Rice 2003 • Draft report for Shared strategy on bull trout due May 2004 (diet of forage fish) • Beschta et al. (1987) • Williams et al. (2001) • Kerwin and Nelson (2000)	• Restore / Moderate • Rehabilitate/ Low-Moderate
All-4	---	Allowing natural flows (including low flows and habitat-forming flows) in a relatively unconstrained river channel will enhance habitat diversity and provide habitats that can support spawning and rearing salmon at a greater variety of flow conditions, thereby leading to expanded salmon spatial distribution, greater juvenile salmon growth, and higher survival. [Note: Less applicable to marine nearshore]	• Implement a flow regime that more closely reflects the natural flow regime, including natural peak flows that create side channels and enhance mainstem habitat in unconstrained portions of the river • Set back levees to allow river to meander within the broader channel zone and to reduce scour related impacts by allowing high flows to spill over banks to connected floodplain. If levees cannot be set back, then manage flow regime to prevent losing a significant portion of year class due to redd scour • Implement a flow regime that augments base flow during low flow periods • Preserve inflow of groundwater from the White River	• All-1 • All-3 • Low-1 • Mid-1 • Mid-5	• Egg incubation • Juvenile freshwater rearing • Adult holding • Adult spawning	• Improve egg-to-fry survival • Enhance rearing habitat • Expand spawning ground availability • Improve spawning ground quality • Enhance rearing habitat	• Abundance • Productivity • Diversity • Spatial Structure	• Natural disturbance creates more diverse and complex habitat for salmon • Habitat complexity enhances productivity and increases life history diversity • Scour impacts on redds are excessive and limit egg-to-fry survival		• Restore / Moderate

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All-6	---	Preventing new bank/shoreline armoring and fill and removing existing armoring, fill and other impediments (e.g., levees) will enhance habitat quality and quantity and lead to improved juvenile salmon survival, spatial distribution, and diversity.	• Use best management practices (BMPs) (e.g., setbacks and buffers) when developing in aquatic areas, especially flood and landslide hazard areas • Remove bulkheads, levees, and other impoundments • Remove fill and allow natural inundation by fresh and tidal waters to create wetlands, marshes, and side channels • Reconstruct estuaries, wetlands, flats, and beaches to expand spatial area/shallow habitats for refuge, prey production, migration, and physiological transition • Restore sediment transport processes	• Near-2 • Near-3 • Near-4	• All lifestages	• Increase prey production • Increase refugia • Provide high energy/flow refuge • Enhance migration corridor • Expand rearing habitat	• Abundance • Productivity • Diversity • Spatial Structure	• Increased habitat area, complexity, and diversity would result in increased species abundance, productivity, and diversity	• Williams et al. (2001) • Williams and Thom (2001) • WDOE (1994) • Terich and Schwartz (1993)	• Preserve / High • Restore / Moderate
Near-2	---	Protecting and increasing the availability of vegetated shallow nearshore and marsh habitats will enhance habitat quantity and quality and lead to greater juvenile salmon residence time, greater growth, and higher survival.	• Add material to dredged areas or remove fill to create shallow habitat with natural gradient and substrate sizes and replanting/reseeding with appropriate submerged aquatic vegetation • Replace or cap low quality fill material • Remove nearshore shoreline armor and overwater structures to allow access to upper intertidal zones and reduce impacts to shoreline energy • Protect and restore shallow nearshore corridor	• All-6	• Juvenile foraging/rearing • Juvenile migration • Juvenile predator avoidance	• Increase food availability • Improve predator refuge • Enhance migration corridor • Enhance rearing habitat	• Abundance • Productivity • Spatial Structure • Diversity	• Restoration of shallow water habitats will increase the production of prey items consumed by juvenile salmon. • Enhanced prey availability will enhance survival.	• Simenstad et al. (1982) • Brennan and Higgins (2004) • Phillips (1984) • Toft et al. (2004)	• Restore / Moderate
Near-3	---	Protecting and restoring nearshore sediment transport processes by reconnecting sediment sources and removing shoreline armoring that impacts sediment transport will lead to greater prey production, greater juvenile salmon growth and higher survival.	• Reconnect beach feeding sources to intertidal zone and allow for bluff erosion. Also, protect/restore low bank shorelines • Remove shoreline armor and fill • Undertake beach nourishment where above actions cannot be taken	• All-6	• Adult/subadult foraging • Juvenile foraging/rearing	• Increase food availability • Enhance migration corridor • Enhance rearing habitat • Increase and enhance forage fish spawning habitat	• Abundance • Productivity	• Restoration of nearshore processes will increase the production of prey items consumed by juvenile salmon. • Enhanced prey availability will enhance survival.	• Shipman (2004) • Dethier and Schoch (2000)	• Preserve / High • Restore / Moderate

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Duw-1	0 – 11	Expanding and enhancing the Duwamish estuary, particularly vegetated shallow subtidal and intertidal habitats and brackish marshes by restoring dredged, armored, and filled areas, will enhance habitat quantity and quality and lead to greater juvenile salmon residence time, greater growth, and higher survival.	• Expand estuarine habitats • Provide off-channel habitats for early estuarine rearing • Add appropriately-sized, clean sediment material to dredged areas to create shallow habitat with natural gradient and substrate sizes • Remove fill material where appropriate to maintain spatial and structural complexity • Remove shoreline armor and overwater structures • Re-establish marsh vegetation and mudflats • Restore riparian vegetation	• Near-2 • Duw-3	• Early estuarine rearing of subyearling and yearling outmigrants	• Increase food availability • Improve predator refuge • Enhance migration corridor • Enhance rearing habitat • Expand physiological transition zone	• Abundance • Productivity • Diversity • Spatial Structure	• Improved estuarine habitat will increase residence time, growth, and survival • Restoration of shallow water habitats will increase the production of prey items consumed by juvenile salmon. • Enhanced prey availability will enhance survival.	• Nelson et al. (2004) • Simenstad et al. (1982) • Ruggerone and Jeanes (2004)	• Restore / Moderate • Rehabilitate / Low-Moderate • Substitute / Low
Duw-3	5.5 – 7	Enlarging the Duwamish River estuarine transition zone habitat by expanding the shallow water and slow water areas will enhance habitat quantity and quality of this key chinook salmon rearing area, leading to greater juvenile salmon residence time, greater growth, and higher survival.	• Remove fill and provide large off-channel habitats for early estuarine rearing • Add riparian and wetland vegetation buffers • Add material to dredged areas to create shallow habitat with natural gradient and substrate sizes	• Duw-1	• Brackish water rearing of fry and fingerling life stages	• Increase food availability • Expand physiological transition zone • Increase refugia • Expand rearing habitat	• Abundance • Productivity • Diversity	• Fish will expand habitat use to areas that are newly available • The limited extent of the salinity transition zone due to modifications of the Lower Duwamish River reduces salmon residence time and growth • Improved estuarine habitat will increase residence time, growth, and survival	• Nelson et al. (2004) • Congleton et al. (1981) • Weitkamp and Ruggerone (2000)	• Restore / Moderate • Rehabilitate / Low-Moderate • Substitute / Low
Duw-5	0-11	Protecting and restoring natural sediment process (supply-transport-delivery) will increase the quantity and quality of available juvenile salmon rearing habitat, including salmon prey production.	• Minimize intentional removal of suitable sediment . • Add appropriately-sized, clean sediment material to create shallow habitat with natural substrate sizes •	• All-8 • Near-3 • Low-2 • Mid-3 • Up-4	• Freshwater and estuarine rearing of juvenile salmon	• Increase food availability • Expand physiological refugia • Expand and enhance shallow water refuge • Enhance juvenile migration corridor from estuary to marine nearshore	• Productivity • Abundance • Diversity • Spatial structure	• The Duwamish is lacking sediment quantity due to supply interruption at HHD, flow regulation and hydromodification of river and stream banks. Localized erosion of stream banks continues to occur but does not provide the natural quantity or size distribution which would occur naturally. The lack of supply coupled with regular maintenance dredging for ship navigation is resulting in a degrading estuary and reducing sand/mudflat habitat which is important for salmon rearing.	• Kerwin and Nelson 2000 • Williams, 2001 • GeoSea Consulting, 1994	• Preserve • Substitute

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Low-1	11 – 32	Protecting and creating/restoring habitat that provides refuge particularly side channels, off channels, and tributary access), habitat complexity (particularly pools) for juvenile salmon over a range of flow conditions and at a variety of locations (e.g., mainstem channel edge, river bends, and tributary mouths) will enhance habitat quality and quantity and lead to greater juvenile salmon residence time, greater growth, and higher survival.	• Reconnect off-channel areas • Add LWD to provide a low velocity habitats during high flow events Add riparian vegetation enhancement and buffers • Reduce steep riverbanks through levee setbacks • Protect cold water sources that can provide temperature refugia	• All-3 • All-6 • Duw-4 • Mid-1	• Egg incubation • Freshwater rearing • Adult holding • Adult spawning	• Increase food availability • Improve refugia from predators • Expand physiological refugia • Provide high flow refuge • Enhance migration corridor • Improve spawning ground quality	• Abundance • Productivity • Diversity • Spatial Structure	• Loss of habitat that serves as refuge in the Lower Green River limits freshwater productivity, diversity and spatial structure • Lack of refuge habitat in upper estuary causes salmon to migrate downstream prematurely, particularly during high flow events	• Nelson et al. (2004) • Ruggerone and Jeanes (2004)	• Restore / Moderate
Mid-1	32 – 64.5	Protecting and creating/restoring habitat that provides refugia (particularly side channels, off channels, and tributary access), habitat complexity (particularly pools) for salmon over a range of flow conditions and at a variety of locations (e.g., mainstem channel edge, river bends, and tributary mouths) will enhance habitat quality and quantity and lead to greater salmon residence time, greater growth, and higher survival.	• Reconnect off-channel areas • Add riparian vegetation enhancement and buffers to provide a source of future LWD • Add LWD to provide a low velocity habitats during high flow events	• All-3 • All-6 • Duw-4 • Low 1	• Egg incubation • Freshwater rearing • Adult holding • Adult spawning	• Increase food availability • Improve predator refuge • Expand physiological refugia • Provide high energy/flow refuge • Enhance migration corridor • Improve spawning ground quality	• Abundance • Productivity • Diversity • Spatial Structure	• Lack of refuge habitat in causes salmon to migrate downstream prematurely	• Nelson et al. (2004) • Ruggerone and Jeanes (2004)	• Restore / Moderate
Mid-3	32 – 64.5	Protecting and restoring natural sediment recruitment (particularly spawning gravels) by reconnecting sediment sources to the river will help maintain spawning, adult holding, and juvenile rearing habitat.	• Riparian protection/enhancement • Set back levees to reconnect natural sediment sources to allow for side channel formation and LWD recruitment • Add natural gradation of sediment (i.e., boulder-gravel-sand) to allow for pool, spawning bed, side channel and shallow water rearing habitat formation.	• Low-2	• All life stages	• Expand rearing habitat availability • Expand spawning ground availability • Improve spawning ground quality	• Abundance • Productivity	• Improved spawning habitat in the Lower Green River will increase spawning and increase egg-to-fry survival • Natural sediment recruitment will improve access to tributaries	• Perkins (1993)	• Restore / Moderate • Substitute / Low
Mid-4	Newaukum Creek and Soos Creek (lower 0-4 miles in both systems)	Preserving and restoring spawning and rearing habitat in lower Newaukum and Soos Creeks will increase habitat quality and quantity, thereby increasing productivity and spatial structure of Green River chinook salmon.	• Riparian protection/enhancement • Maintain/restore riparian vegetation • Limit development-related impacts • Protect cold water sources	• All-2 • All-3 • Mid-2	• All life stages	• Increase food availability • Improve predation refuge • Provide high energy/flow refuge • Improve spawning ground quality	• Abundance • Productivity • Diversity • Spatial Structure	• Improved habitat quality in tributaries will lead to increased fish use, extended rearing time in freshwater, and increased survival • Newaukum and Soos creeks can provide quality habitat for wild salmon	• Kerwin and Nelson (2000)	• Preserve / High • Restore / Moderate

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Up-1	64.5 – 93	Establishing/restoring chinook salmon access above HHD by providing passage upstream (trap and haul) beyond HHD and the reservoir for natural origin chinook and downstream passage for the progeny as well as first generation hatchery fry will increase habitat quantity and expand salmon spatial structure. (Alternate Hypothesis: Augmenting restoration of salmon populations above HHD by re-introducing spring chinook from a neighboring river system (possibly White River) will expand chinook distribution, diversity, and enhance abundance in the river.) (Alternate Hypothesis: Restoring salmon above HHD without the use of hatchery outplants or returning hatchery adults will recover chinook without bypassing important evolutionary processes (i.e., the selection of the fittest adults for spawning, and juveniles for incubation). *Note: Final decisions on which fish to pass upstream are dependent upon NOAA Fisheries, USFWS, and the co-managers (WDFW and Muckleshoot Indian Tribe)*	• Construct fish ladder/collection facility to collect and/or selectively pass adult fish • Construct a downstream fish passage facility		• All life stages	• Expand rearing habitat • Expand spawning habitat	• Productivity • Diversity • Spatial Structure	• Availability of expanded habitats will lead to expanded salmon distribution and life history diversity	• USACE (2000)	• Restore / Moderate • Substitute / Moderate
Up-4	64.5-93	Protecting and restoring natural sediment recruitment process by reducing the amount of slides and road-borne sediment will enhance salmon migration, spawning success and juvenile rearing.	• Restore and protect riparian corridors • Close and/or pave roads • Avoid logging unstable slopes • Rehabilitate reservoir delta	• Near-3 • Duw-5 • Low-2 • Mid-3	• Adult spawning • Adult migration • Juvenile incubation • Juvenile rearing • Resident rearing	• Improve egg survival • Increase food availability • Enhance rearing habitat • Improve spawning ground quality and access	• Productivity • Spatial structure • Abundance	• Upper watershed sediment regime is being adversely affected by forest practices.	• Kerwin and Nelson 2000	• Preserve • Restore
Non-Habitat-1	---	Employing live capture techniques to harvest hatchery salmon (marked) and release natural salmon will reduce mortality of naturally-produced salmon while providing the opportunity to harvest a greater percentage of hatchery fish and thereby reducing straying of hatchery fish to the spawning grounds. [Note: Ranking of this hypothesis is based on the presumption of a segregated stock]	• Use non-lethal fishing gear to target hatchery fish • Increase harvest of hatchery fish	•	• Adult	• Increase adult survival • Reduce interbreeding	• Abundance • Productivity • Diversity	• The ability to keep fish alive and distinguish between hatchery and natural salmon will allow more natural fish to be released • By limiting catch of natural salmon, higher percentage of hatchery population can be harvested • Interbreeding has led to decreased productivity, abundance, and diversity of natural chinook	• PSIT and WDFW (2001)	• N/A

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Non-Habitat-2	---	Modifying hatchery practices (e.g., more natural rearing conditions, smaller releases, release timing and location, genetic management, etc.) and improving the attractiveness of hatcheries to returning hatchery adults will lead to reduced interactions between hatchery- and naturally-spawned chinook salmon, and enhance production of naturally spawned chinook.	• Retrofit hatcheries to allow for natural rearing conditions • Adjust release timing and release location to minimize overlap with natural population • Limit release numbers to carrying capacity • Use only natural origin adults as broodstock • Enhance imprinting on unique odors prior to release • Add weir on mainstem upstream of Soos Creek to prevent hatchery straying	•	• Adults • Fry • Smolts	• Reduced hatchery and wild fish interactions • Increase spawning by natural origin adults	• Abundance • Productivity	• Reducing difference between hatchery and natural salmon while also reducing spatial and temporal overlap will reduce negative interactions on wild fish survival	• HSRG (2003)	• N/A
Tier 2										
All-1	---	Protecting and improving water quality (e.g., temperature, dissolved oxygen, turbidity, and chemical contamination conditions) by addressing point and nonpoint (specifically stormwater runoff and agricultural drainage) pollution sources will enhance habitat quality and lead to greater juvenile salmon growth, disease resistance, and survival. Improved water quality will also enhance survival of adult salmon, incubating salmon eggs, and salmon prey resources, such as forage fish.	• Retrofit stormwater detention and treatment facilities in urban and industrial areas • Reduce CSO discharges • Repair/replace failing septic systems • Remove creosote treated wood • Protect groundwater sources that provide cold water, e.g., connection to White River and Deep/Coal Creek subbasins • Protect tributaries and springs that provide cold water, particularly in the lower and middle river sections • Manage agricultural runoff to reduce nutrient and waste loading to streams • Restore freshwater and saltwater marshes that reduce runoff rates • Reduce non-point air pollution	• All-2 • Low-3	• All lifestages	• Improve egg survival (both salmon and forage fish) • Increase food availability • Expand physiological refugia • Enhance resistance to disease • Enhance migration corridor • Enhance rearing habitat • Improve adult homing and upriver migration survival • Pollution abatement • Soil stability • Erosion control	• Abundance • Productivity	• Degraded water quality reduces the production of prey items consumed by juvenile salmon. • Enhanced prey availability will enhance growth and survival. • Degraded water quality influences juvenile salmon fitness and disease resistance. • Degraded water quality influences adult homing and upriver migration survival. • Improved water quality will contribute to adults having more energy for gamete development, upriver migration, and spawning that will lead to higher egg incubation survival.	• Powell et al. (2002) • Arkoosh et al. (1999) • Stein et al. (1995) • WDOE (2002)	• Rehabilitate/ Low-Moderate
All-3	---	Protecting and improving access to tributaries will increase the quantity of available habitat, particularly for juvenile chinook and coho salmon, and lead to expanded salmon spatial distribution, greater juvenile salmon growth, and higher survival.	• Remove culverts and flapgates that are perched or otherwise limit fish access, particularly access to rearing areas for juvenile chinook and coho • Modify tributary mouth configuration to improve access over range of flow conditions • Restoring natural sediment recruitment and reducing channel downcutting	• Low-4	• All lifestages	• Increase food availability • Expand areas providing refuge from predators • Provide high energy/flow refuge • Enhance migration corridor • Expand rearing habitat • Expand spawning ground availability	• Abundance • Diversity • Spatial Structure	• Salmon utilization of tributaries will increase with improved access and habitat condition • Increased utilization will lead to longer residence times and higher survival	• Kerwin and Nelson (2000)	• Restore / Moderate

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All-5	---	Preserving and protecting against watershed and upland impacts by implementing Low Impact Development techniques, including minimizing impervious surfaces, will maintain habitat quality by helping maintain flow and reduce sedimentation, thereby leading to greater salmon survival.	• Maximize forest retention and minimize impervious surfaces through improved site design • Use pervious materials, such as pervious concrete, for hard surfaces such as parking areas • Maintain/restore riparian area native vegetation • Maintain vegetation to the maximum extent practicable on all development sites • Purchase conservation easements • Implement stormwater management techniques that promote infiltration and reduce water quality impacts (especially temperature and turbidity)	• All-1 • All-2 • Low-3 • Mid-2 • Mid-5	• All lifestages	• Maintain food availability • Maintain physiological refuge • Maintain migration corridor • Maintain rearing habitat • Maintain adult homing and upriver migration survival	• Abundance • Productivity	• Degraded watershed conditions and functions reduce the quantity and quality of instream habitat • Reduced quantity and quality of instream habitat reduces productivity and diversity of salmon		• Restore / Moderate • Preserve / High
Near-5	---	Protecting and enhancing pocket estuaries (i.e., small non-natal smaller estuaries, lagoons, and spits) and salmon-bearing and non-salmon bearing tributary mouths by maintaining/ restoring tributary mouths will increase quantity of key habitat and lead to greater juvenile salmon growth and survival.	• Remove shoreline armoring around tributary mouths to widen small creek deltas • Remove armoring that channelizes the lower reaches of tributaries and along shorelines in order to expand the transition zone to salt water • Restore alongshore sediment processes • Protect/restore riparian vegetation along pocket estuaries	• All-3	• Adult foraging (cutthroat, and possibly others) • Prey production • Juvenile transition • Migration • Juvenile foraging/rearing	• Increase food availability • Maintain or expand physiological transition zone	• Abundance • Productivity • Diversity • Spatial Structure	• Increasing spatial diversity of available habitats will support greater life history diversity • Enhancing pocket estuaries will lead to increased growth and survival	• Beamer et al. (2003) • Hirschi et al. (2003)	• Preserve / High • Restore / Moderate
Duw-4	7 – 11	Protecting, creating, and restoring habitat that provides refugia (particularly side channels, off channels, and tributary access), habitat complexity (particularly pools) for juvenile salmon over a range of flow conditions and at a variety of locations (e.g., mainstem channel edge, river bends, and tributary mouths) will enhance habitat quality and quantity and lead to greater juvenile salmon residence time, greater growth, and higher survival.	• Reconnect off-channel areas • Add LWD to provide a velocity break from high flow velocities	• All-3 • All-6 • Low-1	• Freshwater and estuary rearing • Adult holding	• Increase food availability • Improve predator refuge • Expand physiological refugia • Provide high flow refuge • Enhance migration corridor • Improve spawning ground quality	• Abundance • Productivity • Diversity • Spatial Structure	• Lack of refuge habitat in upper estuary causes salmon to migrate downstream prematurely	• Nelson et al. (2004) • Ruggerone and Jeanes (2004)	• Restore / Moderate

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Duw-6	0-11	Protecting and improving water quality (e.g., temperature, dissolved oxygen, metals and organics) by addressing point and nonpoint (specifically stormwater runoff) pollution sources will enhance habitat quality and lead to greater juvenile salmon growth, disease resistance, and survival. Improved water quality will also enhance survival of adult salmon, and salmon prey resources.	• Retrofit stormwater detention and treatment facilities in urban and industrial areas • Reduce CSO discharges • Remove creosote treated wood • Restore freshwater and saltwater marshes that reduce runoff rates • Reduce non-point air pollution	• All-1	• Freshwater and estuary rearing • Adult holding	• Increase food availability • Enhance resistance to disease • Enhance migration corridor • Enhance rearing habitat • Improve adult homing and upriver migration survival • Pollution abatement	• Abundance • Productivity	• Degraded water quality reduces the production of prey items consumed by juvenile salmon. • Enhanced prey availability will enhance growth and survival. • Degraded water quality influences juvenile salmon fitness and disease resistance. • Degraded water quality influences adult homing and upriver migration survival. • Improved water quality will contribute to adults having more energy for gamete development, upriver migration, and spawning that will lead to higher egg incubation survival.	• Powell et al. (2002) • Arkoosh et al. (1999) • Stein et al. (1995) • WDOE (2002)	• Rehabilitate/ Low-Moderate
Low-2	11 – 32	Restoring and enhancing sediment recruitment (particularly spawning gravels) by reconnecting sediment sources to the river will reduce channel downcutting, increase shallow habitats, improve access to tributaries, and improve spawning habitat, thereby leading to greater juvenile salmon residence time, greater growth, and higher survival.	• Set back levees to reconnect natural sediment sources • Set back levees to allow for side channel formation and LWD recruitment • Target sediment sources upriver • Add riparian vegetation enhancement and buffers	• Mid-3	• Freshwater rearing • Adult holding • Adult spawning	• Expand rearing habitat availability • Expand spawning ground availability • Improve spawning ground quality	• Abundance • Productivity • Diversity • Spatial Structure	• Reduced sediment recruitment limits the availability of suitable spawning habitat • Improved spawning habitat in the Lower Green River will increase spawning • Natural sediment recruitment will improve access to tributaries	• Kerwin and Nelson (2000) • Nelson et al. (2004)	• Restore / Moderate • Substitute / Low
Mid-2	32 – 64.5	Protecting against watershed and upland impacts by implementing Low Impact Development techniques (see All-5) will be particularly beneficial in the sub-watersheds of tributaries that provide spawning (e.g., Newaukum and Soos Creeks) and/or rearing habitat (e.g., Jenkins and Covington Creeks) will increase habitat quality and quantity and promote utilization of non-mainstem habitats and prevent creating additional stressors that limit survival.	• Use pervious materials, such as pervious concrete, for hard surfaces such as parking areas • Maintain/restore native vegetation in riparian corridors and all development sites, particularly in rural areas • Buffers on all wetlands, streams, and shorelines • Implement stormwater management techniques that promote infiltration and reduce water quality impacts (especially temperature and turbidity).	• All-1 • All-2 • All-5 • Mid-4 • Mid-5	• All lifestages	• Maintain food availability • Maintain physiological refuge • Maintain migration corridor • Maintain rearing habitat • Improve adult homing and upriver migration survival	• Abundance • Productivity • Diversity • Spatial Structure	• Degraded watershed conditions and functions reduce the quantity and quality of instream habitat • Reduced quantity and quality of instream habitat reduces productivity and diversity of salmon		• Preserve / High

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Mid-5	45 – 58	Maintaining regional groundwater recharge and base flows to the mainstem Green River through forest retention and Low Impact Development will maintain spawning and rearing habitat.	• Protect natural hydrology • Protect cold water springs • Maintain and restore instream habitat • Restore floodplain habitat connectivity	• All-1 • All-5 • All-7 • Low-3 • Mid-2 • Mid-4	• All life stages	• Increase food availability • Maintain holding area quality	• Abundance • Productivity	• Groundwater provides an important source of cold water which contributes to keep river temperatures lower • Degraded watershed conditions and functions reduce the quantity and quality of instream habitat • Reduced quantity and quality of instream habitat reduces productivity and diversity of salmon	• Kerwin and Nelson (2000)	• Preserve / High
Up-2	64.5 – 93	Protecting and restoring/enhancing habitat (e.g., side channels, pools) along the upper Green River mainstem and major tributaries (e.g., North Fork, Smay Creek) by restoring the riparian corridor will enhance habitat quality and lead to greater residence time and survival (after the establishment of populations above HHD]).	• Remove or repair failing logging roads • Restore native vegetation • Maintain wide riparian corridor • Add LWD • Tacoma Water continues to manage land holdings in upper watershed (approximately 10 percent of land) as a "natural" forest management zone which will keep those areas largely intact	• All-2 • Up-1	• Egg incubation • Juvenile rearing • Adult holding • Adult spawning	• Improve egg survival • Increase food availability • Enhance rearing habitat • Improve spawning ground quality	• Abundance • Productivity • Diversity • Spatial Structure	• Improved habitat in upper watershed will enhance fish survival and lead to extended residence times and increased survival • Runs are re-established in upper watershed	• USACE (2000)	• Preserve / High • Restore / Moderate
Up-3	64.5 – 93	Establish bull trout population above HHD by providing passage upstream (trap and haul) beyond HHD and the reservoir for returning adults and downstream passage for the progeny increase habitat quantity and expand spatial structure. *Note: Final decisions on which fish to pass upstream are dependent upon NOAA Fisheries, USFWS, and the co-managers (WDFW and Muckleshoot Indian Tribe)*	• Construct fish ladder/collection facility to collect and/or selectively pass adult fish • Construct a downstream fish passage facility	•	• All life stages	• Expand rearing habitat • Expand spawning habitat	• Diversity • Spatial Structure	• Upper watershed provides habitat to support bull trout	• Watson and Toth (1994)	• Restore / Moderate
Tier 3										
Near-1		Protecting and improving sediment quality, particularly in Elliott Bay will enhance habitat quality and lead to greater juvenile salmon growth and higher survival.	• Remove or remediate contaminated sediments • Address nonpoint sources through stormwater management and riparian vegetation management • Repair/replace failing septic systems • Cap contaminated sediments to remove from biologically active zone	• All-1 • Duw-2	• Juvenile foraging/rearing • Juvenile migration	• Increase food availability • Enhance resistance to disease • Increased growth	• Abundance • Productivity	• Sediment quality reduces the production of prey items consumed by juvenile salmon. • Enhanced prey availability will enhance survival.	• Powell et al. (2002) • Arkoosh et al. (1999) • Stein et al. (1995)	• Preserve / High • Restore / Moderate • Rehabilitate/ Low-Moderate

Summary of Tiered Conservation Hypotheses

ID	Targeted River Miles (RM)	Draft Conservation Hypothesis	Example Actions	Related Conservation Hypotheses	Lifestages Targeted	Targeted Functions	VSP Parameters Addressed	Key Assumptions	Data/ References	Habitat Management Strategy Type / Relative Certainty1
Near-4	---	Protecting and expanding forage fish spawning areas by maintaining/ increasing high intertidal zone access and maintaining/ increasing availability of suitable substrate sizes will lead to greater juvenile salmon growth and higher survival.	• Protect existing shoreline sections with suitable substrate in the appropriate intertidal elevations for forage fish spawning • Remove shoreline armoring to expand availability of high intertidal areas and minimize scouring actions that remove suitably sized substrate from the armored shoreline reach • Restore native vegetation in riparian areas to provide overhanging vegetation to reduce possibility of egg desiccation, among other functions	• All-6 • Near-2 • Near-3	• Juvenile foraging/rearing • Adult foraging	• Increase food availability • Enhance rearing habitat	• Abundance • Productivity	• Expanded forage fish spawning areas will lead to greater prey availability for juvenile and adult salmon. • Enhanced availability of forage fish prey will enhance salmon survival	• Brennan and Higgins (2004) • Fresh et al. (1981) • Brodeur (1990)	• Preserve / High • Restore / Moderate
Duw-2	0 – 11	Protecting and improving sediment quality will enhance habitat quality and lead to greater juvenile salmon growth, disease resistance, and higher survival.	• Remove or remediate contaminated sediments • Address nonpoint sources through stormwater management and riparian vegetation management • Repair/replace failing septic systems • Cap contaminated sediments to remove from biologically active zone	• All-1 • Near-1	• Early estuarine rearing of subyearling and yearling outmigrants • Adult migration • Adult holding	• Increase food availability • Enhance resistance to disease	• Abundance • Productivity	• Sediment quality reduces that production of prey items consumed by juvenile salmon. • Enhanced prey availability will enhance survival.	• Powell et al. (2002) • Arkoosh et al. (1999) • Stein et al. (1995)	• Rehabilitate / Low-Moderate
Low-3	11-32	Preserving and maintaining groundwater inflow from historical White River channel will contribute to maintaining river flows and good water quality, thereby leading to greater juvenile and adult salmon survival.	• Protect White River groundwater connection to Green River	• All-1	• Freshwater rearing • Adult holding	• Maintain rearing habitat • Enhance migration corridor	• Abundance • Productivity	• Water quality downstream of the White River is limiting productivity • White River groundwater continues to provide a significant inflow during low flow periods		• Preserve / High
Low-4	Black River	Modifying the Black River Pump Station to allow fish passage will increase habitat quantity and lead to greater juvenile salmon residence time and growth.	• Allow fish passage above the Black River Pump Station, particularly into Springbrook Creek	• All-3	• Freshwater rearing	• Expand rearing habitat	• Abundance • Productivity • Diversity • Spatial Structure	• Water quality and quantity is adequate to support juveniles		• Restore / Moderate
Mid-6	61 – 64.5	Restoring chinook salmon access between the Tacoma Diversion Dam (TDD) and Howard Hanson Dam (HHD) by providing passage upstream and downstream at the TDD for natural origin chinook will increase habitat quantity and expand spatial structure.	• Construct fish ladder/collection facility to collect and/or selectively pass adult fish • Construct a downstream fish passage facility *Note: Tacoma Water is constructing an adult fish ladder, trap, sorting facility, and water-to-water transfer facility at the TDD to enable passage of adult fish into the Green River watershed upstream of HHD and a juvenile bypass facility around the TDD for migrants from the upper watershed. Currently there are no plans to provide adult salmon access between TDD and HHD due to concerns about the effects of decaying salmon carcasses on the municipal water supply.*	• Up-1	• All life stages	• Expand rearing habitat • Expand spawning habitat	• Abundance • Diversity • Spatial Structure	• Salmon will spawn in reach if allowed access		• Restore / Moderate

Summary of Tiered Conservation Hypotheses

ID	Targeted River Miles (RM)	Draft Conservation Hypothesis	Example Actions	Related Conservation Hypotheses	Lifestages Targeted	Targeted Functions	VSP Parameters Addressed	Key Assumptions	Data/ References	Habitat Management Strategy Type / Relative Certainty1
Non-Habitat - 3	---	Reducing harvest of nonsalmonid commercially and recreationally important species (e.g., Dungeness crab, and forage fish) will lead to greater prey availability for juvenile and adult salmonids	• Work with WDFW to reduce harvest of forage fish	•	• Adult foraging Juvenile foraging	• Foraging	• Abundance • Productivity	• Forage fish are a primary component of chinook diets as they get larger than 150mm. Reducing direct harvest of a prey item will increase its availability to chinook and increase growth and survival	• Brennan and Higgins (2004) • Fresh et al. (1981) • Brodeur (1990)	• N/A

Note: 1) Strategy type and degree of certainty as defined in the "Integrated Recovery Planning for Listed Salmon: Technical Guidance for Watershed Groups in Puget Sound" by the Puget Sound Technical Recovery Team and Shared Strategy Staff Group (Draft February 3, 2003). Relative certainty was presented based on an increasing uncertainty of success in achieving VSP parameters in order of the strategy types from protect (least uncertainty), restore, rehabilitate, to substitute (most uncertainty).
Yellow highlight denotes references cited by Technical Committee without a full citation provided.