INDEPENDENT MULTIDISCIPLINARY SCIENCE TEAM (IMST)

State of Oregon

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This letter report addresses issues related to instream aggregate (gravel and sand) mining regulated by the Division of State Lands (DSL) in Oregon and how operations may affect salmonid habitat. Five general features determine the suitability of aquatic habitats for salmonids: flow regime, water quality, habitat structure, food sources, and biotic interactions (Spence et al. 1996). Habitat requirements vary by life stages and salmonid species. Spawning areas are selected on the basis of instream flow, water quality, substrate size (gravels), and groundwater upwelling. Embryo survival and fry emergence depends on substrate condition including gravel size, porosity, permeability, dissolved oxygen, substrate stability during high flows and water temperature. Instream aggregate mining (and placer mining) can directly impact salmonids by degrading and simplifying spawning and rearing habitats, increasing turbidity and decreasing substrate stability thereby influencing lower trophic levels upon which salmonids depend on for food (Spence et al 1996).

This report is narrowly focused to address the Independent Multidisciplinary Science Team's (IMST) technical review of the 1995 report released by the Oregon Water Resources Research Institute entitled "Gravel Disturbance Impacts on Salmon Habitat and Stream Health" as requested by former DSL Director, Paul Cleary (letter dated June 11, 1999). This request was a result of Governor Kitzhaber's Executive Order No. EO 99-01, Sections (3)(K) and (3)(l). The Executive Order directed DSL to 1) in conjunction with Oregon Department of Fish and Wildlife (ODFW), "consult with OWRC [Oregon Water Resources Commission] to determine where necessary to administratively close priority areas (including work under [DSL's] General Authorizations) to fill and removal activities in order to protect salmonids", and 2) "seek the advice of the IMST regarding whether gravel removal affects gravel and/or sediment budgets in a manner that adversely affects salmonids".

This report is organized to 1) present background information on the 1995 Oregon Water Resources Research Institute's report, 2) IMST's independent review of this 1995 report, 3) issues needing further consideration by DSL, and 4) specific recommendations to DSL, the State Land Board, ODFW, and the Core Team for the Oregon Plan for Salmon and Watersheds. This report does not include an in-depth examination of DSL's Removal-Fill Law or flood plain mining under the Department of Geology and Mining Industries' (DOGAMI) Mined Land Reclamation Program but rather a broader view of managing gravel as a resource and potential effects on salmonids.

Kondolf (1994) suggested that since floodplain mining pits can become part of the active channel, they should be viewed as being potentially instream when viewed on a time scale of decades. Loss of aquatic habitat may occur when river channels are captured by mining pits present in active flood plains. This has occurred during a 1997 flood on the Rogue River in Jackson County, Oregon (DOGAMI 2001) and has been documented in other areas of Oregon, California, Washington, and Alaska (Kondolf 1997, Dunne and Leopold 1978, Woodward-Clyde Consultants 1980). DOGAMI regulates floodplain mining and is also in the process of examining how floodplain mining operations can help provide off channel habitat for salmonids and other aquatic resources. Therefore discussions within this report may benefit both DSL and DOGAMI as they manage mined resources.

Oregon Water Resources Research Institute's 1995 Report

Senate Bill 81, section 101 (Fish Habitat) revised statutory requirements of ORS 196.810 (Removal-Fill Law) included requirements that 1) DSL require permits for any removal or fill activity proposed in *essential indigenous anadromous salmonid habitat* except for specific activities defined in the legislation, and 2) DSL conduct a study to examine the relationship between the removal of material from streams and stream health as it relates to carrying out the provisions in the Removal-Fill Law.

In 1993, in order to fulfill the second listed requirement, DSL entered into an interagency agreement with Oregon State University's Oregon Water Resources Research Institute (OWRRI) to conduct an assessment, which would:

- Examine the relationship between the removal of material (rock, gravel, sand, silt, or other inorganic material) from streams and stream health in support of essential indigenous salmonid habitat,
- Enhance DSL's knowledge of stream processes and impacts on salmon habitat for application to review of permit requests to remove gravel bars,
- Examine potential benefits and problems of gravel removal in streams, and
- Answer questions about gravel removal impacts on salmon habitat such as pool depths, sedimentation at spawning beds, stabilization, of riverine habitat, removal rate vis-à-vis recruitment rate, and channel and bank stability.

In 1995, OWRRI issued a report on this work entitled: *Gravel Disturbance Impacts on Salmon Habitat and Stream Health, Vols. I and II* (OWRRI 1995). The report made several recommendations (listed below) to improve management of removal-fill operations (nos. 1 and 2), to improve comprehensive management of removal-fill operations (nos. 3 -6), and for research activities related to removal-fill operations (nos. 7-9).

In this section we summarize each OWRRI recommendation and list actions taken by DSL, as determined through available reports and information provided by DSL personnel. The OWRRI (1995) recommendations were discussed with Ann Hanus, DSL Director, and John Lilly, DSL Assistant Director, at IMST's public meeting July 12, 2001. Comments from the discussion and ones prepared by Director Hanus after the meeting were used in revising summaries of DSL actions.

OWRRI Recommendation 1. Improve data collection related to removal and fill laws

1a. Conduct monitoring and research to evaluate impacts.

IMST Summary: OWRRI found no Oregon-specific studies to evaluate and/or monitor the environmental impacts of aggregate extraction or material filling. This lack of specific field data to support the removal-fill permit process hinders the goals of protection, preservation, and best use of water resources stated under ORS 196.805.

DSL Actions: DSL has significantly increased their compliance monitoring for commercial permits state-wide and for recreational and small placer-mining in essential salmonid habitat and/or State Scenic Waterways. DSL is currently able to monitor about 10 to 15% of the active gravel removal permit sites per year; and about the same percentage of the total active permit sites. Gravel bar scalping/removal also has a required pre-harvest and post-harvest surveys and another survey the following spring to determine if enough gravel recruitment occurred over the winter to allow harvest to occur in the next season. They have not started any effectiveness or validation monitoring efforts.

1b. Improve DSL database capabilities and use.

IMST Summary: DSL needs to develop methods to document removal-fill activities and to incorporate this data into Geographical Information System (GIS) supported analysis. The present DSL data collection process is incapable of adequately monitoring removal-fill activities.

DSL Actions: DSL's corporate database called the Land Administrative System (Information Resource Management Plan), which includes new databases for removal-fill permits, complaints/violations and wetland mitigation, was initiated in late 1999. This system was designed with an active GIS interface. Reports from the system and remote access were addressed in 2000.

DSL received grant money to complete fisheries information in the Natural Heritage Data Bank, update and maintain the wildlife and habitat information, convert databases to GIS format, and provide assistance to watershed councils in accessing and using the database.

1c. Implement GIS-based resource management.

IMST Summary: DSL needs to fully implement a GIS-based resource management system for removal-fill activities. This system could identify areas of high resource use or permit application that are in essential habitats for sensitive, threatened, or endangered species. The system could identify reaches being aggraded or degraded, reaches and watersheds were sediment budgets show depleted gravel resources and poor re-supply from up-stream areas.

DSL Actions: DSL's Land Administration System (LAS) was designed with an active GIS interface. The agency has recently solved related hardware problems that were preventing frequent use of the GIS function. Staff training is planned to increase the GIS function of the LAS. In addition DSL is preparing to link other data sets (e.g. Oregon Natural Heritage Program) and some imagery. All Essential Salmon Habitat streams and Scenic Waterways are included as a GIS layer accessible from LAS.

1d. Allocate sufficient financial resources and staff to monitor resource abundance, condition, and use.

IMST Summary: DSL personnel often lack time for site visits to monitor and verify extraction amounts and environmental safeguards. Royalties from mining operations are not used directly for staff, but are transferred to the general school fund. A direct linkage needs to be developed between royalties and support of staff that monitor and issue permits for removal operations.

DSL Actions: The removal-fill program, including its wetland conservation component, is funded in part by gravel royalties and other revenues (including removal-fill permit fees) derived from the use of the State's waterways. The 2001 Legislature authorized the addition of two limited duration staff positions to assist in the waterway and rangeland management programs. DSL largely remains understaffed.

OWRRI Recommendation 2. Minimize additional degradation of salmonid habitat.

2a. Prohibit, regulate, or otherwise manage small operations.

IMST Summary: DSL should regulate small removal operations (less than 50 cubic yards) to prevent direct and indirect impacts to sensitive, threatened, or endangered species and their habitats.

DSL Actions: DSL revised its administrative rules governing issuance of removal-fill permits in spawning and rearing areas identified by ODFW as essential indigenous anadromous salmonid fish habitat (in 1996 the Land Board adopted the Essential Indigenous Salmonid Habitat Maps and Rules).

Permits are now required for operations removing or filling less than 50 cubic yards in these designated areas. Administrative rules were also developed regarding recreational and small-scale placer mining affecting less than 25 cubic yards in designated habitat areas under the Removal-Fill Law. Approximately 17,700 miles of streams (18% of the total stream miles) in Oregon were designated as essential salmonid habitat. Recent revisions increased stream miles to 17,917. The 1997 Legislature removed the artificial limit on Essential Salmonid Habitat designations (i.e. 20% of a waterway).

2b. Conduct removal-fill operations in a manner to minimize potential impacts on salmonid habitat.

IMST Summary: DSL should develop a manual-of-practice that records and describes successful methods to minimize impacts to salmonid habitats. DSL personnel should be regional experts in minimization of removal-fill impacts and they should have written documents that support and foster that expertise.

DSL Actions: Currently ODFW district biologists review all applications for various activities and DSL actively seeks their response as well as Tribe's and Watershed Council's. Similarly National Marine Fisheries Service (NMFS) and US Fish and Wildlife Service (USFWS) are notified and asked to comment on each application. Recommendations for project changes are taken to the applicant.

DSL developed Best Management Practices (BMPs) for commercial gravel removal in the Umpqua Basin in 1999. Commercial gravel removal BMPs for other basins state-wide and BMPs for other removal-fill activities are under development by DSL with the assistance of a multi-agency and stakeholder group. Completion of these BMPs was planned for 2001, but efforts were redirected to update removal-fill rules and completing a programmatic consultation with NMFS and USFWS on all federally-listed species in connection with obtaining a State Programmatic General Permit from the US Army Corps of Engineers.

2c. Allow bar skimming gravel removal under restricted conditions.

IMST Summary: DSL should conduct bar skimming under the following restricted conditions: 1) the gravel bar is not an active spawning, rearing, or feeding area for salmonids; 2) adequate gravel recruitment exists so that the bar is typically replenished each year; 3) berms and buffer strips be used to control stream flow away from the location of gravel removal; 4) gravel is removed only during low flows and from above the low-flow water level; and 5) the final grading of the gravel bar does not significantly alter the flow characteristics of the river at high-flows.

DSL Actions: All the points listed above are addressed through permit conditions. DSL limits gravel removal from individual bars to annual recruitment for all permits (requires pre- and post-harvest surveys and a follow up survey to determine if sufficient recruitment over the winter has occurred before scalping can continue the following season); the bar can not be scalped below the water line at summer low flows; and the bar must be graded to so it does not interfere with fluvial geomorphology. Instream work is restricted to periods specified by ODFW inwater-work timing guidelines.

DSL's planned review of whether limiting removal to annual recruitment provides adequate protection for fluvial geomorphology and other aquatic resources was referred to the IMST, per Executive Order 99-01.

2d. Restrict deep water dredging for gravel production to areas where presently practiced.

IMST Summary: Deep water gravel dredging represents significant and permanent alteration of stream bed elevations and should not be initiated at new sites or extended beyond its present application without extensive review because of the unknown long-term direct and indirect impacts of this practice may have.

DSL Actions: Deep water dredging is being restricted to existing sites on the Columbia, lower Willamette, and the Umpqua rivers.

2e. Do not allow a net loss of wetlands for all removal-fill operations.

IMST Summary: Preference should be given to the protection and preservation of natural wetlands over reconstructed wetlands resulting from mitigation. Careful monitoring over time should be used as wetland loss is often an unintended, insidious process. Wetlands produced from flood-plain gravel removal could be used to mitigate of necessary fill operations, thus providing incentive for the conversion of former gravel removal sites into functioning wetland systems.

DSL Actions: DSL has found that the regulatory program is an effective, but not a fully comprehensive tool to limiting wetland loss. The program does not regulate all activities that cause loss (e.g. projects in wetlands involving less than 50 cubic yards of material); and the replacement of lost wetland functions through mitigation is not always successful. The new rules now under public review require the establishment of a mitigation goal and success criteria as permit conditions. DSL's current rules require mitigation ratios greater than one to one for such activities as wetland creation (1.5 to 1) and wetland enhancement (3 to 1).

DSL is working with the Oregon Progress Board to establish a Benchmark for wetland loss in connection with regulated activities. DSL wetland program staff is also in the process of developing a hydrogeomorphic wetland and riparian assessment program for the State. This is a specific methodology for assessing wetland and riparian classification, function and values in a geographic context.

2f. Use biological streambank stabilization methods where possible.

IMST Summary: Biological streambank stabilization methods have improved in recent years and these methods should be recommended over riprap, concrete groins, or abutments because they provide benefits to salmonid populations including stream shading and generation of large wood.

DSL Actions: A DSL study in 1997-99 looked at erosion control projects in eastern and western Oregon. In areas sampled, riparian buffers, bioengineered treatments, bank sloping, etc. were conditions of the permits in a very high percentage of projects. The revised General Authorization for erosion control requires that most activities use bioengineering techniques. If riprap is to be used it must consist of clean, erosion resistant angular rock from an upland source.

OWRRI Recommendation 3. Improve present policy by the Burden of Proof of "no significant impact" shifting to permit applicants.

IMST Summary: Resources to clearly identify indirect impacts of removal-fill operations on specific salmon stock are not currently, and may never be, available. In the absence of a clear understanding of removal-fill impacts, salmonids and their habitats need to be conservatively protected. For those proposed activities that are projected to result in significant indirect impacts, it is recommended that the burden of proof of "no significant" impacts be sifted to the persons proposing the activity. Resource coordinators for DSL need to develop and adopt criteria that will assess which activities can be adequately regulated by "business-as-usual" approaches, and which ones cannot. It is proposed that all activities that cause a significant shift in streams away from natural habitat conditions be considered ineligible for the normal permitting process.

DSL Actions: DSL feels that the burden remains on the permit applicant/permittee to demonstrate compliance with the law, DSL's standards fro project approval and/or the permit conditions, whichever is applicable.

The volume of work has grown three and half fold over the last 10 years (1989-1991; total permits issued = 717; 1997-1999: total permits issued = 2487) due to the robust economy and the results of several flooding events. The same increases have been seen in violation reporting and case resolution; compliance monitoring; wetland determinations and local wetland land use notices. As a result, DSL added five new positions since 1993-1995

Biennium and devised methods of permitting/monitoring (e.g. small scale placer mining general authorization; tidegate sediment removal general authorization). These efforts by the agency as well as other minor changes to the rules is their attempt to focus agency resources on larger, more complex projects while allowing the smaller projects with less impact to go through an abbreviated review and approval process if the applicants can clearly qualify their project to pre-set permit conditions.

OWRRI Recommendation 4. Do not allow gravel extraction from reaches of DSL-managed streams that support sensitive, threatened, or endangered species.

IMST Summary: Gravel extraction from reaches of DSL-managed streams that support spawning, rearing, and feeding of listed sensitive, threatened or endangered fish species (salmonids or others) should not be allowed. In addition, it is recommended that this restriction be applied to streams that support chum or coho salmon because of their seriously declining populations. The severity of the population declines and the lack of definite information regarding potential impacts of removal-fill operations make this the only reasonable and prudent approach to responsible management of these populations.

DSL Actions: DSL maintains that their database shows that during 1997-99 a total of 690 authorizations were issued for removal-fill work within Essential Salmonid Habitat (ESH) streams; of these 690 authorizations over 400 were for small scale placer mining or fish habitat enhancement. Less than 25 authorizations were for any activity associated with gravel extraction. In 1999, the Land Board increased the ESH stream miles from approximately 4,5000 river miles to approximately 17,600 river miles. DSL feels that given the number of approved activities, the level of activity and the operating conditions imposed by the permit on these activities, the impacts have been mitigated or are within an acceptable range.

DSL had about 65 active sand and gravel extraction operations currently under permit on waterways such as the South Umpqua, Willamette, Columbia, Chetco, and Rogue Rivers. Almost all operations are bar scalping; the Umpqua, Willamette, and Columbia are typically deep water dredging.

OWRRI Recommendation 5. Do not allow gravel extraction from reaches of DSL-managed streams that are part of aquatic diversity areas or support source salmon populations.

IMST Summary: Gravel extraction should not be allowed from DSL-managed rivers and streams that support the best remaining examples of aquatic biodiversity and salmon populations. These areas have decreased substantially due to development, yet are significant baseline representations of healthy ecosystems and can be used to measure the impacts of activities such as gravel disturbance.

DSL Actions: Response is similar to that listed with recommendation 4. DSL adds that the location of aquatic diversity areas or reaches that have been identified as source salmon areas are not currently data layers in the agency's GIS system. DSL is reviewing ODFW's recent work on the designation of "anchor habitat areas" to determine: (1) how the designation fits with the DSL's Essential Salmonid Habitat areas; and (2) whether or not there is a need to amend removal-fill permit program rules to require greater consideration to regulated activities within these areas.

OWRRI Recommendation 6. Promote recycling efforts.

IMST Summary: DSL should work cooperatively with the Department of Geology and Mineral Industries (DOGAMI), Department of Environmental Quality (DEQ), and the Department of Transportation (ODOT) to encourage aggregate recycling to decrease the demand for stream gravel resources.

DSL Actions: DSL finds that this recommendation concerns activities that are beyond their ability to carry out. The promotion of sand and gravel recycling efforts is more appropriately the responsibility of the larger aggregate users such as ODOT and DOGAMI.

OWRRI Recommendation 7. Develop plans to increase gravel availability.

IMST Summary: Nearly all current removal-fill activities in Oregon's streams result in a decrease of streambed gravel. While gravel removal is increased or maintained, gravel production from upstream sources is often reduced through erosion control activities. Coupled with large-scale flood-control projects that reduce upland flooding, erosion, and bed-load transport, the availability of gravel in-stream is clearly declining.

DSL Actions: We found no indication that this issue is being addressed by DSL or any other agency. To accomplish this DSL would have to coordinate with other agencies that have regulatory authority over flood-

control projects and upland areas. DSL finds that this recommendation concerns activities that are beyond their ability to carry out.

OWRRI Recommendation 8. Develop strategies to increase salmonid and aquatic habitat.

8a. Develop methods to convert former flood plain gravel pits into productive habitat.

IMST Summary: Lakes and ponds resulting from floodplain gravel operations may represent a valuable resource for the creation of aquatic habitat. DSL needs to work cooperatively with the gravel mining industry and local planning authorities to develop efforts to re-establish and restore these areas for aquatic habitat. Pilot projects should be initiated to demonstrate best methods of development and the advantages and disadvantages of specific approaches.

DSL Actions: DSL is conducting a pilot study funded by a surcharge assessed to gravel operators on the mainstem Willamette to assess the viability of connecting two former gravel pits (Truax and Endicott Lakes) to the mainstem.

8b. Use gravel mining as a potential method for developing wetlands, off-stream channels, lakes and ponds, and potential salmonid spawning beds.

IMST Summary: DSL should develop resource maps of old stream channels in flood plains that contain economically-recoverable quantities of gravel. Cooperative ventures could be developed so that portions of the gravel can be removed to form wetlands, channels, lakes, ponds, and spawning areas. DSL and DOGAMI should develop cooperative plans to facilitate permit applications for such efforts.

DSL Actions: This has not yet been done.

OWRRI Recommendation 9. Ensure compatibility of policies with existing watershed initiatives in Oregon.

Summary: DSL needs to develop a watershed approach to management of gravel resources and this effort should be coordinated with other state watershed programs. DSL policies should not erode options of future watershed initiatives nor create conditions requiring subsequent restoration. Removal-fill operations must be consistent with these watershed programs to ensure efficient use of public funds.

DSL Actions: This recommendation is being approached, in part, through DSL's involvement with the Oregon Plan for Salmon and Watersheds.

IMST's Independent Review of the 1995 OWRRI Report

The IMST conducted an independent review of the OWRRI (1995) report and found it to be technically sound. We endorse the report and the recommendations included. The work for this report was conducted prior to the implementation of the Oregon Plan for Salmon and Watersheds (Oregon Plan) and the IMST.

As part of the IMST's discussions regarding the report, we found it pertinent to determine what DSL has done to address the OWRRI recommendations. Several of the OWRRI recommendations have been addressed, some were incorporated into DSL's tasks under the Oregon Plan and actions were documented in Oregon Plan Implementation Reports (Oregon Plan 1998, 2000a, and 2000b; available at http://www.Oregon-Plan.org), and a few have not been addressed for various reasons listed with the recommendations in the previous section.

After examining actions taken by DSL to address the OWRRI recommendations and tasks listed in the Oregon Plan, the IMST finds that DSL still manages site specific actions and has not incorporated landscape management into its regulation of permits under the Removal-Fill Law and General Authorizations. Key issues that need to be addressed by DSL and its administrative board, the State Land Board, are channel morphology, bedload transport rates and sediment budgets, cumulative effects, and effectiveness monitoring. These areas are necessary to move the agency from managing individual site-specific activities to managing activities as part of the landscape. We see these as important to salmonid recovery. In the following section we add

additional technical information on these four areas that was not available at the time the OWRRI (1995) report was written or not sufficiently covered by that report.

1. Channel Morphology

The size and shape of a stream or river channel reflects its prevailing flow and sediment load (Kondolf 1994). Meador and Layher (1998) summarized conclusions from an American Fisheries Society Symposium concerning the effects of instream sand and gravel mining. Instream mining typically alters channel geometry, including local changes in gradient and width-to-depth ratios. Point-bar mining increases stream gradient by effectively straightening the stream during floods. Thalweg relocation can occur when flooding connects the stream to floodplain aggregate mines. Local scouring and erosion can occur as a result of increased water velocity and decreased sediment load associated with aggregate mining. Changes in channel stability can also cause a loss of riparian vegetation (Kondolf 1994).

Channel bed incision can occur upstream or downstream from a mining operation (Kondolf 1994). Upstream progression of channel degradation and erosion can occur (also called headcutting) causing dramatic changes in a stream and channel that can affect instream flow, water chemistry and temperature, bank stability, available cover, and siltation (Meador and Layher 1998). Channel incision can lower alluvial water tables and affect riparian vegetation (Kondolf 1994). Other documented effects of gravel mining include bed coarsening, the loss of small gravels and an increase in larger particles (Kondolf 1994).

The premise that instream aggregate mining sites can be replenished without affecting the channel may ignore downstream bed load requirements for channel maintenance and the complex physiochemical and biotic responses to changes in bed load (Meador and Layher 1998). The majority of the bedload in a river is transported during high flows, particularly floods. Multiple factors can slow water velocity in streams and rivers including decreasing gradient, widening of the channel, and friction of transporting bedload across the streambed. In cases where the bedload is lost upstream due to replenishing mined gravel bars or being trapped behind dams, water velocity does not decrease as quickly and as a result the water picks up sediment and new bedloads by eroding banks and removing gravel from other deposits including downstream gravel bars and salmonid spawning beds. Kondolf (1997) has referred to this situation as “hungry water”. Therefore, significant negative changes can occur in channel morphology and aquatic habitat downstream from an instream mining operation.

2. Bedload Transport and Sediment Budgets

DSL does not monitor the actual amount of gravel (cubic volume/operation) or other aggregates removed by instream mining operations, rather it is assumed that the amount removed is less than the amount permitted. The actual harvested volume of a resource is an important determination for any natural resource. With instream aggregate mining a distinction must be made between the total volume removed and replenishment rate (cubic volume replaced/time) (Dunne et al. 1981). The location and form of a gravel bar may be determined by constraints such as bedrock outcrops or other features that control local reach hydraulics, which induces deposition in the same site year after year. Therefore the replenishment rate and abstraction rates must be determined so as not to disrupt the site or the channel downstream (Dunne et al. 1981). In some rivers, large gravel bars may simply indicate long-term deposition rather than a rapid supply rate. In other systems a gravel bar

may be a persistent feature from year to year, but the actual gravel particles may be eroded and replaced every few years with new particles transported from upstream (Kondolf 1994).

Unless viewed within a geological timeframe, gravels are not a renewable resource. The floor of the Willamette Valley consists of thick layers of late Pleistocene and Holocene alluvium that covers all but a few areas of pre-Tertiary rock from Portland to Eugene (Orr et al. 1992). The gravels and sands mined in streams and flood plains were laid down from erosional deposition and glacial outwash from the western Cascades as well as from a series of catastrophic Pleistocene floods from Montana that scoured eastern Washington and Columbia Gorge into what is now the Willamette Valley (Orr et al. 1992). Gravels and other sediments are temporarily stored within river systems in gravel bars, floodplains, and terraces. Klingeman (1987) identified major natural influences on sediment transport including the river's recent geological history, meandering, natural streambed armoring, constraints on bedform development due to natural channel constrictions, and the presence of bedrock outcrops and old cemented gravels. Changes in land uses, bank stabilization, gravel mining activities, and upstream dams may alter sediment transport and supply rates.

The transport of sediment (suspended and bedload) through a river system is continuous on a geological scale but only episodic on a human time scale (Kondolf 1994). Sediment transport occurs as a power function of flow discharge meaning that high flows transport proportionally greater sediment loads than moderate flows (Kondolf 1994). The rate of bedload transport depends on the supply of coarse material from the watershed and the transporting power of the river, which varies over time and space (Kondolf 1994). Gravels and larger particles are mainly transported by high flows and floods. Therefore, annual variations in precipitation, high flows, and flood frequency and magnitude will affect sediment transport. Dams and impoundments can alter the amount of sediment moving through river system by altering high flows and by trapping sediment behind impoundment structures. Therefore, dams interrupt the transport of gravels and decrease the gravel supply to downstream reaches.

A sediment budget is an accounting of sediment sources, rates of sediment flux (quantity and transport) through the stream or river system, losses to or gains from temporary sediment storage reservoirs (such as gravel bars or floodplains) and loss by export from the basin (such as mining or movement to the ocean) (Dietrich and Dunne 1978 as referenced in Kondolf 1994). A sediment budget can typically indicate if exploitation rates approach or exceed annual transport through a mined reach. Studies in Washington's Olympic Peninsula have shown that gravel extraction rates exceeded replenishment rates by more than 10 fold and caused bed incision (Collins and Dunne 1989). In California, a study on gravel mine extraction rates before and after the construction of a dam showed that extraction rates before the dam were 10 times greater than the sediment supply to the reach, but after dam construction, extraction rates were 50 times greater than rate of bedload supply (Kondolf and Swanson 1993). The effects of the mining and sediment trapped behind the dam resulted in the channel incision and lateral migration in the mined reach, and increased erosion rates downstream to regain some of the lost sediment load in the stream flow (Kondolf and Swanson 1993).

Methods for determining bedload and transport rates and sediment budgets are discussed in detain in NCASI (1999) and Collins and Dunne (1990), respectively. The methods used will depend on the nature of the river/stream system and departmental resources. Different

methods could be used on different streams. Both the above publications (as well as others) discuss the pros and cons of the different methods.

3. Cumulative Effects

The Oregon Plan does not define cumulative effects although it does make several references to the necessity of determining cumulative effects particularly for water quality. Cumulative effects have been defined by the National Environmental Protection Act (NEPA) of 1969 as:

> *The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time* (40 CFR 1508.7).

Fish habitat consists of a wide array of physical, chemical, and biological conditions. Modifications to fish habitat occur along geographic, temporal, and activity-related spectrums (Burns 1991). A geographic spectrum ranges from site-specific to global. A temporal spectrum ranges from instantaneous to long-term, and an activity-related spectrum ranges from a single act to multiple complex actions. Cumulative effects contain elements within all three spectra. Because environmental impacts accumulate over time and space, analysis is difficult (Riser 1988).

From a state agency perspective, cumulative effects should take into account the past and present activities they have regulated and activities regulated by other agencies (State, Federal, and local), as well as known unregulated activities within a given watershed. By knowing which activities are occurring, which ones may interact with DSL's regulated activities, and to what extent they may affect aquatic resources, the agency can make professional judgments on limiting and mitigating cumulative impacts to salmonids and their habitats. Within DSL's program, the agency needs to take into consideration, commercial aggregate mining, recreational placer mining, fill operations, stabilization of eroding stream banks, permanent and temporary dams in addition to activities they do not permit but may have effects on stream processes and functions. This can be done on a reach scale and, eventually, a basin scale.

In their draft Biological Assessment, DSL states that:

> *Since DSL authorizes activities on a statewide basis over a prolonged period of time, we cannot predict with precision all of the direct, indirect, and interrelated/interdependent effects that may be associated with each action, either individually or cumulatively. Adverse effects will be minimized by the terms and conditions DSL places on each state Removal-Fill permit or letter of authorization* (DSL 2000; page 36).

In addition they state:

> *Cumulative effects will depend on the types and numbers of permits issued. DSL permit statistics from the 97-99 Biennium, provided under Determinations of Affects under the Federal Endangered Species Act, by Species, will be used as a surrogate (i.e., representative sample of the range*

> *and intensity of adverse affects for all types of removal-fill permits expected to be issued for the next five years* (DSL 2000; page 38).

Cumulative effects will vary with the type of permitted activity. However, the IMST finds no scientific basis for permit statistics to be used as a surrogate for evaluating cumulative effects. The cumulative effects must be assessed or predicted first and then related to the number and types of permits issued for a given time period and geographical area. Without establishing this information on cumulative effects DSL, can not reasonably meet the goals of the Oregon Plan, properly address and modify best management practices, or protect and maintain sustainable aquatic resources across the landscape.

The Council on Environmental Quality (1997) has laid out a process for analyzing cumulative effects under NEPA. Those steps include: 1) scoping, 2) describing the affected environment, and 3) determining the environmental consequences. The Council found that scoping is the key to analyzing cumulative effects as it provides the best opportunity for identifying important cumulative effect issues, setting appropriate boundaries for analysis, and identifying relevant past, present, and future activities. In the case of removal and fill activities, DSL should document what other major activities have occurred (since EuroAmerican settlement when possible) and are occurring in a given reach or basin, how they are perceived to affect the aquatic environment (based on the best available science) in the absence of proposed activity and how they may interact with the proposed activity.

4. Monitoring

Monitoring provides accountability by reducing uncertainty about whether or not management decisions were properly implemented (compliance or implementation monitoring), whether management objectives of protecting and recovering salmonids and their habitats are being achieved (effectiveness monitoring), and whether the management actions taken explain the changes (validation monitoring) (Independent Science Panel 2000). Adaptive management based on monitoring is the foundation for reducing uncertainty in managing ecological systems (Independent Science Panel 2000).

Monitoring conducted by DSL is restricted to monitoring permit compliance, which is documented in their biennial reports (DSL 1997, 1999, and 2000). Since the 1995 OWRRI report and the implementation of the Oregon Plan, DSL has substantially increased their compliance monitoring (OWRRI (1995) Recommendation 1). This type of monitoring is activity specific and often relies on the permit holder to provide information. For example, permit holders of bar scalping operations are required to conduct pre-harvest and post-harvest surveys of the bar they are mining. This process does not include independent verification by DSL or ODFW unless more than one year has elapsed between harvests.

DSL's monitoring program also does not include areas further downstream or upstream of permitted operations, which may be undergoing channel morphology or habitat changes due to mining operations or erosion control measures. Compliance monitoring alone does not provide sufficient information for the agency to determine if best management practices or permit conditions need to be modified in order to protect riparian and aquatic resources. This can only be accomplished through effectiveness monitoring linked with adaptive management.

Effectiveness monitoring asks the basic question: Was the action (e.g. permit conditions, restoration) effective in attaining or maintaining the desired future conditions and in meeting

objectives (Kershner 1997)? Effectiveness monitoring is more complex than compliance monitoring and requires longer time frames and understanding of the physical, biological, and sometimes the social factors that influence aquatic ecosystems (Kershner 1997). As we mentioned earlier, DSL stated in their draft Biological Assessment that "Adverse effects will be minimized by the terms and conditions DSL places on each state Removal-Fill permit or letter of authorization" (DSL 2000; page 36). Under an effectiveness monitoring program, questions that could be addressed are:

- What are the possible adverse effects to salmonids and their habitat that could be caused by permitted activities?
- Are the adverse effects minimized by the terms of a permit and to what degree?

As part of adaptive management the next steps would include:

- Based on monitoring data analysis and interpretation determine which permit conditions are contributing to the degradation of salmonid habitat, channel morphology, and/or aquatic and riparian ecosystem function.
- Determine how those permit conditions could be modified based on the monitoring information.
- After the permit conditions are modified, continue monitoring, evaluation, and modifications in management.

The Independent Science Panel (2000) outlined the necessary elements for a successful monitoring program in an adaptive management context. These elements were used to help create scientifically credible programs and more information can be found in their report.

1. Monitoring should be based on a set of clearly articulated goals, objectives, or questions that need to be addressed,
2. The statistical designs are appropriate,
3. Indicators and variables are based on needs defined by objectives and the appropriate geographical, temporal, and biological scales,
4. Monitoring protocols are standardized to allow comparison among locations, times, or programs,
5. Programs are in place for quality assurance and quality control of the data,
6. Data are managed to allow easy access and coordination among different collaborators,
7. Funding is stable and adequate to allow planning and implementation of sustained long-term efforts, and
8. The information is analyzed and integrated into decision-making.

Conclusions

The Division of State Lands approaches instream mining from an operation (or project) management perspective instead of from a resource management perspective that includes spatial and temporal aspects. Application of the Removal-Fill Law and General Authorizations are done on a site by site basis through individual permits. A paradigm shift needs to occur to shift this

management procedure to one of managing a resource on a basin scale. Gravel as an extractable resource is regulated by two separate agencies, instream mining is regulated by DSL and floodplain mining is regulated by DOGAMI. Within stream and river systems, floodplains and channels are connected and do not function independently of one another. This separation in thinking maintains site specific management approaches. The IMST advocates managing resources from a landscape perspective, which in the case of gravel resources includes the channel, floodplain, and uplands, which supply sediment to the stream/river system. Based on our review of the 1995 OWRRI report and other reports and publications published since them, the IMST has identified four areas that need to be addressed when managing instream gravel resources; channel morphology, bedload transport and sediment budgets, cumulative effects, and effectiveness monitoring.

IMST Recommendations

IMST recommendations are based on our assessment of the best available science as it pertains to salmonid and watershed recovery and the management of natural resource. Recommendations are directed to one or more agencies or entities that have the ability to implement, or to affect changes in management or regulation that are needed for implementation. It should be noted that the IMST looks beyond an agency's *current* ability to implement the recommendations because current legal, regulatory, or funding situations may need to change. It is the belief of the IMST that if an agency agrees that a recommendation is technically sound and would aid the recovery of salmonid stocks and watersheds, the agency would then determine what impediments might exist to prevent or delay implementation and work toward eliminating those impediments. The Team also assumes that each agency has the knowledge and expertise to determine how best to identify and eliminate impediments to implementation and to determine appropriate time frames and goals needed to meet the intent of the recommendation. In addition, the IMST recognizes that an agency may already have ongoing activities that address a recommendation. Our inclusion of such an "overlapping" recommendation should be seen as reinforcement for needed actions.

Recommendation 1. The Oregon Plan Core Team should develop a statewide policy on the management of stream sediments and bedload transport.

The IMST recognizes the social demand for gravel and other aggregates mined from streams and active floodplains. Because of cost related to transportation, most of the mining occurs near urban and industrial centers where the aggregates are used. Multiple federal, state, and local agencies currently play roles in regulating aggregate mining. The State needs a policy that adequately addresses the sustainability of the resource and protecting the function and quality of riparian and aquatic ecosystems while meeting the future demand for aggregate resources to the degree that is environmentally sound.

During policy development the Core Team may want to consider the following elements:

- Identify one agency to have oversight on all floodplain and instream mining operations.
- Provide the means for the State to conduct impact analysis for stream systems, not just for individual operations.
- Manage sediments trapped behind dams and mitigate for sediment-poor stream sections below dams.

- Incorporate elements of the National Marine Fisheries Service's National Gravel Extraction Policy (NMFS 1996).
- Based on final commercial product, determine priority levels of aggregate mining from within channels and active floodplains. The State could encourage use of products that do not require the high quality sorted aggregates from channels and are more likely to occur in areas that are more suited for reclamation or mitigation. Others sources may include reservoir deltas, dredger tailings, inactive river terrace deposits, upland quarries, and recycling of aggregates (Kondolf 1998).
- Reflect changing land use practices that may affect future sediment inputs to streams, which in turn may affect the availability of commercial aggregates.

Recommendation 2. DSL should develop and integrate a basin level approach into its management policies.

While permits are issued on a site-specific basis, DSL should work toward maintaining the integrity and connectivity of stream ecosystems. This approach requires the integration of individual projects into a landscape framework to allow sound management decisions at both scales. To this end, the following recommendations support managing at a basin level.

Recommendation 3. DSL should determine sediment budgets and bedload transport rates on stream reaches with permitted aggregate mining operations.

Responsible management of natural resources requires information on the status, abundance, quality, and distribution of the resource. Oregon currently issues permits for gravel removal without knowing how much gravel resource remains and the trends in the status of the gravel resource.

Studies conducted in Washington and California have shown that mining within stream channels and active floodplains remove aggregates at rates exceeding the supply from catchments by an order of magnitude or more (Collins and Dunne 1989, Kondolf and Swanson 1993). No comparable studies are available for Oregon. Sediment budgets need to be developed to determine if current practices and future practices are not causing degradation of stream/river beds and or a decline in gravels within a stream/river system and if extraction rates can be sustained. Bedload transport rates must be known in order to estimate the rate of sand and gravel replenishment. These are particularly critical for streams regulated by dams. Method(s) for determining sediment budgets and bedload transport vary by stream systems. See Collins and Dunne (1990) and NCASI (1999) for further discussion on available methods. (Crossed referenced with OWRRI recommendation 7, this report)

Recommendation 4. DSL should track the actual amount of aggregate removed by permit holders.

Presently, DSL does not track the actual amount (cubic volume/operation) of aggregate removed by operators. The agency assumes that the actual amount is less than the permitted amount. As with any sustainable resource, such as timber, the amounts of aggregate harvested must be known in order to determine if the harvested amount exceeds the long-term supply or is deleterious to stream system functions. To properly determine sediment budgets, DSL needs to know the amount of material removed from each operation. Site surveys prior to mining and

after mining could quantify the amount of removal and compared to the amount of material permit operators haul from the site.

Recommendation 5. DSL, in cooperation with ODFW, should assess the cumulative impacts of aggregate mining on streams with declining salmonids.

Cumulative effects include the documentation of current conditions, how past activities may have affected conditions, what other activities are occurring in the reach or basin affecting the operation site and determining how these may interact with a proposed activity. Monitoring of cumulative effects may include short-term monitoring of caged fish during the mining activity, long-term aquatic population trends in the affected reaches, and assessment of aquatic life (macroinvertebrates, aquatic algae and higher plants and all fish species (not just salmonids). To increase the effectiveness of DSL's resource management this recommendation should be applied to all regulated activities including placer mining and fill operations. (Cross referenced with OWRRI recommendations 1a, 1c, and 2b, this report)

Recommendation 6. DSL should increase the technical expertise of geomorphology and hydrology within the agency.

Currently DSL does not have a staff geomorphologist. This expertise in channel dynamics and sediment dynamics is essential to properly examine how removal-fill operations may affect channel morphology upstream or downstream from an operation or to conduct on-site evaluation to determine if modifications need to be made to permit conditions or best management practices. Additionally these areas of expertise are needed to determine sediment budgets and if current bar-skimming practices are significantly decreasing gravel supplies downstream from operations.

Recommendation 7. ODFW and DSL should identify critical salmonid migration routes not currently protected under the *Essential Indigenous Salmonid Habitat* (ORS 196.810(b); OARS 141-102-0000 thru 0040) designation where impediments to migration be occurring due to removal-fill activities.

> **Recommendation 7a. The Land Board and DSL should provide protection for critical salmonid migration routes identified by ODFW and DSL.**

Currently the *Essential Indigenous Salmonid Habitat* designation only recognizes critical spawning and rearing areas and may not provide adequate protection for migration corridors, particularly in lowland systems. Anadromous salmonids use lowland river systems as migration corridors two or more times (depending on species) during their life cycle. As juveniles, salmonids may spend several weeks in the lower portions of a river before entering estuaries and oceans and require unobstructed access to these habitats. Juvenile migration may be impeded by physical, chemical, and thermal conditions. Returning adults passing through areas with removal/fill activities require sufficient holding and resting sites. Habitat modification from dredging, bar scalping, or fill activities may change migration patterns, simplify habitat, increase predation rates, and affect rearing potential in these rivers.

Recommendation 8. DSL and ODFW should develop an effectiveness monitoring program to determine if permit conditions under the Removal-Fill Law and General Authorizations maintain and protect salmonid fish habitat including gravel substrate, fish populations, and riparian conditions.

Currently DSL only conducts compliance monitoring on Removal-Fill and General Authorization permits. An effectiveness monitoring program is needed to determine if the conditions of the permits are providing both short- and long-term protection of salmonid habitat and populations, and the condition and function of riparian and wetland areas. DSL should work with ODFW and other agencies as appropriate to develop an effectiveness monitoring program that includes overall strategy and design, assessment of personnel and resource needs, monitoring implementation and evaluation at mining sites and affected reaches.

Recommendation 9. State Land Board and DSL should develop an adaptive management process that is linked to the effectiveness monitoring program.

Information gained from an effectiveness program needs to be linked to policy development through an adaptive management framework. The State Land Board and DSL should evaluate current policies and develop an appropriate framework. They may want to examine the current management structure used by Oregon Department of Forestry and the Forest Practices Act.

Recommendation 10. DSL should incorporate both the technical aspects of the 1995 report, *Gravel Disturbance and Impacts on Salmon Habitat and Stream Health*, prepared by the Oregon Water Resources Research Institute into their operations and policies, and the recommendations in this report.

The IMST independent review finds the Oregon Water Resources Research Institute to be technically sound and endorses both the report and the recommendations included. The information and recommendations within the report will assist DSL in better managing instream gravel sources and salmonid habitats. IMST has added several new recommendations that were not contained in the 1995 OWRRI report.

We hope that these comments and recommendations assist the State of Oregon in developing sound management practices of instream gravel resources and to assist in the recovery of salmonids and watersheds.

Sincerely,

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References

Burns, D.C. 1991. Cumulative effects of small modifications to habitat. Fisheries. 16(1): 12-15.

Council on Environmental Quality. 1997. Considering cumulative effects under the National Environmental Policy Act. Council of Environmental Quality, Executive Office of the President. Washington D.C.

Collins, B.D. and Dunne, T. 1989. Gravel transport, gravel harvesting, and channel bed degradation in rivers draining the southern Olympic Peninsula, Washington, U.S.A. Environmental Geology and Water Sciences. 13 (3) 213-224.

Collins, B. and Dunne, T. 1990. Fluvial geomorphology and river-gravel mining: A guide for planners, case studies included. California Department of Conservation, Division of Mines, Sacramento, California.

Department of Geology and Mineral Industries (DOGAMI). 2001. Cascadia. 1(3): 4.

Dietrich, W.E. and Dunne, T. 1978. Sediment budget for a smooth catchment in mountainous terrain. Z. Geomorph. Suppl. 29: 191-206.

Division of State Lands, Oregon (DSL). 1997. Summary of Activities in the Removal–Fill Program for Waters of the State for the 1993-1995 Biennium. Oregon Division of State Lands, Salem, Oregon.

Division of State Lands, Oregon (DSL). 1999. Summary of Activities in the Removal–Fill Program for Waters of the State for the 1995-1997 Biennium. Oregon Division of State Lands, Salem, Oregon.

Division of State Lands, Oregon (DSL). 2000. Programmatic Biological Assessment, Section 7 consultation pursuant to Federal Endangered Species Act (16 U.S.C. 1531 *et seq*.) State of Oregon's Removal–Fill Program. Final September 1, 2000. Oregon Division of State Lands, Salem, Oregon.

Division of State Lands, Oregon (DSL). 2000. Summary of Activities in the Removal–Fill Program for Waters of the State for the 1997-1999 Biennium. Oregon Division of State Lands, Salem, Oregon.

Dunne T., Dietrich, W.E., Humphrey, N.F., and Tubbs, D.W. 1981. Geologic and Geomorphic implications for gravel supply. pp. 38–74 in Proceedings from the Conference: Salmon-Spawning Gravel: A renewable resource in the Pacific Northwest? October 6–8, 1980. Report no. 39, State of Washington Research Center, Pullman, Washington.

Dunne, T. and Leopold, L.B. 1978. Water in Environmental Planning. W.H. Freeman and Co., San Francisco, California.

Independent Science Panel. 2000. Recommendations for monitoring salmonid recovery in Washington State. Report 2000-2. Independent Science Panel. Olympia, Washington.

Kershner, J.L. 1997. Monitoring and adaptive management. In Watershed restoration: Principles and Practices. American Fisheries Society, Bethesda, Maryland. pp. 116-131.

Klingeman, P.C. 1987. Geomorphic influences on sediment transport in the Willamette River. pp. 365-374 in Beschta, R.L, Blinn, T., Grant, G.E., Swanson, F.J., and Ice, G.G. (eds.)

Erosion and Sedimentation in the Pacific Rim. International Association of Hydrological Sciences. Capital City Graphics, Salem, Oregon.

Kondolf, G.M. 1994. Geomorphic and environmental effects of instream gravel mining. Landscape and Urban Planning. 28: 225–243.

Kondolf, G.M. 1997. Hungry water: effects of dams and gravel mining on river channels. Environmental Management. 21 (4): 533–551.

Kondolf, G.M. 1998. Large-scale extractions of alluvial deposits from rivers in California: geomorphic effects and regulatory strategies. *In* Gravel-Bed Rivers in the Environment, edited by Klingeman, P.C., Beschta, R.L., Komar, P.D., and Bradley, J.B. Water Resources Publications, LLC, Highland Ranch, Colorado. p. 455–470.

Kondolf, G.M. and Swanson, M.L. 1993. Channel adjustments to reservoir construction an gravel extraction along Stony Creek, California. Environmental Geology. 21: 256–269.

Meador, M.R. and Layher, A.O. 1998. Instream sand and gravel mining: Environmental issues and regulatory process in the United States. Fisheries. 23 (11): 6-13.

National Council of the Paper Industry for Air and Stream improvement (NCASI). 1999. Scale considerations and the delectability of sedimentary cumulative watershed effects. Technical Bulletin No. 776. national Council of the Paper Industry for Air and Stream Improvement, Inc. Research Triangle Park, NC.

National Marine Fisheries Service (NMFS). 1996. NMFS National Gravel Extraction Policy. Adopted August 29, 1996. US Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service. (available at http://swr.ucsd.edu/hcd/gravelsw.htm)

Oregon Water Resources Research Institute (OWRRI). 1995. Gravel disturbance impacts on salmon habitat and stream health. Vols. 1 and 2. Oregon Water Resources Research Institute, Oregon State University, Corvallis.

Orr, E.L, Orr, W.N., and Baldwin, E.M. 1992. Geology of Oregon, 4th edition. Kendall/Hunt Publishing Co. Dubuque, Iowa.

Riser, P.G. 1988. General concepts for measuring cumulative impacts on wetland ecosystems. Environmental Management. 12 (5): 585-589.

Spence, B.C., Lomnicky, G.A., Hughes, R.M., and Novitzki, R.P. 1996. An ecosystem approach to salmonid conservation. TR-4501-96-6057. ManTech Environmental Research Services Corp. Corvallis, Oregon.

Woodward–Clyde Consultants, Inc. 1980. Gravel removal guidelines manual for Arctic and Subarctic floodplains: report to US Fish and Wildlife Service, contract FWS-14-16-0008-970, WWS/OBS-80/09, 169 p.