SUMMARY AND RECOMMENDATIONS CONCERNING THE USE OF BUFFER ZONES USED TO PROTECT AQUATIC RESOURCES IN THE PLEASANT VALLEY PLAN DISTRICT PLAN

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INTRODUCTION:

The City of Gresham plans to annex portions of Pleasant Valley including the middle portions of Kelley Creek drainage, and develop it as a residential area. A document entitled "Pleasant Valley Plan District Plan", (PVPDP), has identified Environmentally Sensitive Natural Restoration Areas (ESRA), with these goals in mind:

> "The environmentally sensitive/restoration areas (ESRA) are resource management areas with important ecological functions. While not affecting the continued use of existing homes, it is the long-term goal to restore and enhance sensitive wetlands and stream corridors to create a functional riparian system. This goal recognizes that additional inventory and analysis is needed to further refine what types of activities are to be allowed within the ESRA areas.
>
> **Characteristics**
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> Areas identified as existing habitat types on the Resource Management Map include wetlands, upland, and riparian habitat. Wetlands range from open water to forested wetlands. Upland habitat range from deciduous and conifer forests to shrubs and habitats of mixed species. • • • • Areas identified for restoration as part of the Resource Management Map embody a vision for the valley. These restoration and enhancement measures might include strategies to:
>
> 1. Remove fish passage barriers;
> 2. Restore native plant and animal communities through removal of invasive species, plant native trees and shrubs;
> 3. Reconnect creeks, floodplains and habitat to improve natural system functions and reduce flooding;
> 4. Restore wetlands and stream banks to reduce erosion, reduce landslide hazards, and improve water quality and fish habitat; and
> 5. Reduce water quality degradation through re-vegetated stream buffers, stream friendly stormwater management, and reduced pollutant discharges.
>
> A trail system, as designated on the map along the edges of the ESRA, connects the neighborhoods of the valley to each other, the schools, the parks, and the town center. Trails also help direct human activity to appropriate locations and serve as an indicator of the edge between the natural and more cultivated landscapes. Neighborhood and Community parks adjoining ESRA serve as trailheads by providing access."

Given these goals, the ESRA is defined using a matrix of criteria. (Harker, 2005). The factors in the matrix are:

? Water Quality
? Channel Dynamics
? Water Quantity, Stream Flow Sources and Storage
? Microclimate
? Fish and Aquatic Habitat

- ? Organic Materials
- ? Riparian and Upland Wildlife Habitat Quality
- ? Upland Sensitive Species

Due to the mechanics of the matrix, the "Fish and Aquatic Habitat" factor is the dominant factor that drives much of the ESRA designations in the PVPDP. ETC biologists have analyzed the matrix, and the Fish and Aquatic Habitat factor in particular as it was applied in the PVPDP.

MECHANICS OF THE ESRA MATRIX:

The Fish and Aquatic Habitat portions of the PVPDP's ESRA criteria matrix are shown in Table 1 (highlight added):

Table 1 – Extracted from Table 2 of the PVPDP Chapter 6.

Resource Functions	Land Features with Functional Value	Land Features	Primary Factor
Fish and Aquatic Habitat	In-water habitat structure. Certain configurations of pool and riffle sequences in the stream channel, off-channel wetlands, side channels, oxbows, meanders, backwaters, frequently flooded areas (10-year flood or higher frequency), known spawning gravel.	Aquatic Habitat	- Within 100' of high or medium rated stream segment - Within 50' of low rated stream segment
		Sensitive Species	- All land within 200' of a channel meander zone of a stream containing aquatic sensitive species or potential habitat for sensitive species[5]
		Wetlands	- All inventories wetlands
		Floodplain	- All land within channel meander zone of accessible reach.
5. Includes all stream meander zones downstream from a high or medium fish habitat rated stream segment or aquatic sensitive species point.			

The significance of the highlighted portions of the above table is has the affect of applying a 200 foot buffer width to all portions of Kelley Creek downstream of Reach 8 in the ODFW[1] survey due to the presents of cutthroat trout in that reach.

For the purpose of this discussion, ETC biologist divided Kelley Creek into the following reaches:

1) Lower, as described as Reaches 1 and 2 in the ODFW surveys. Beginning at the confluence of Johnson creek and extending to the north end of Kelley Creek Farms, and including the confluence of Clatsop Creek. Repeated fish surveys have noted cutthroat trout, lamprey, and red-legged frogs year around in this reach. Fish and aquatic habitat is rated as low to high quality.
2) Middle, as described as reaches 3, 4, 5, 6 and 7 of the ODFW surveys, including Mitchell Creek. These extend from Kelley Creek Farms, past 190th Avenue to the middle of a pasture. They include most of the stream area that the city of Gresham is planning to annex. ODFW has conducted only one fish survey in this reach in July of 2000. Fish and aquatic habitat rating is mostly low to medium quality, with one high quality section in Reach 3.
3) Upper, as described as reaches 8 and 9 in the ODFW surveys. These extend to the head water of the creek. ODFW has conducted one fish survey in this reach in July of 2000. Reach 8 was rated "excellent", and 9 as low quality.

This analysis concerns:

[1] ODFW stream surveys are the source of the high/medium/low rating system used to rate these streams.

? Kelley Creek's current and potential habitat for fish and aquatics. Two fish species of concern are found in Kelley Creek, the Western Brook Lamprey, and the Cutthroat Trout. Another species of concern is the red-legged frog, (Rana aurora draytonii), which is listed as a threatened species.
? The width of the buffer zones needed to maintain this habitat.
? Reviews the criteria used to define the Fish and Aquatic Habitat criteria as it is applied in the Pleasant Valley Plan District Plan (PVPDP), for the purpose of defining the Environmentally Sensitive/Restoration Areas (ESRA).

THE SCIENCE BEHIND THE ESRA MATRIX:

The goal of natural resource managers should be to use the best available science in making recommendations designed to protect and preserved habit for sensitive species. The PVPDP specifically allows that the buffer zones be integrated into a system of parks and trails. While these are noble purposes, and will help create a desirable community, raise property values, and make a place where people

Figure 1. The references cited in the ESRA for justifying the buffer width shown in Table 1. Copied from Table 3 of Chapter 6 of the PVPDP.

	FUNCTION	STUDY	MINIMUM WIDTH[3] OR SIZE THRESHOLD
Fish and Aquatic Habitat	Cutthroat trout	Hickman and Raleigh 1982	98 ft
	Chinook salmon	Raleigh et al. 1986	98 ft
	Cutthroat trout, rainbow trout and steelhead	Knutson and Naef 1997	50 – 200 ft
	Maintenance of benthic communities (aquatic insects)	Erman et al. 1977	100 ft
	Shannon index of macroinvertebrate diversity.	Gregory et al. 1987	100 ft
	Trout and salmon influence zone (Western Washington)	Castelle et al. 1992	200 ft
			Range of width for function 50 - 200 ft.

will want to live, work, they are not justified by the needs of protecting habitat for sensitive species. In ETC's opinion, the ESRA should be focused on habitat issues, and not be confounded with other issues. Accordingly, we focused our analysis on the riparian and wildlife issues, and leave it to others to determine what areas should be reserved for parks and recreation.

The PVPDP cites six studies that are used to develop the recommendations for buffer size presented in the plan. The relevant portion is copied below:

We reviewed the six studies shown in Figure 1. What we found was that they did not provide the best available science for determining riparian buffers. We also found that they had been quoted incorrectly in the PVPDP. In fairness to the authors of the PVPDP, much of the ESRI model they used appears to have been copied and quoted from previous works, and the problems arising from the use of inappropriate sources and inaccurate quotations from those sources were in most cases made in those previous works.

All the papers shown in Figure 1 are review papers. For the most part, they do not report results from the author's own studies, but rather review and synthesize data from a number of previous studies. As common practice in such papers, authors will discuss the findings of other scientists, and then present their own conclusions from that information, and their own scientific insights. In some cases, the PVPDP uses some data found in an author's discussion section which contrasted with the authors own conclusions and recommendations. This has the effect of quoting an expert opinion as saying one thing, when in reality the expert's actual opinion was something a bit different.

In other cases, the study cited presents no data or supporting information to justify a buffer of any particular size, but yet the PVPDP treats the study as an authoritative work. Consider the following quote from Terry

Hickman and Robert Raleigh's 1982 paper; which is the first reference listed in Figure 1. This paper models the suitability of trout habitat as a function of a stream's physical parameters;

> "In most cases, a buffer strip about 30m deep, 80% of which is either well vegetated or has stable rocky stream banks, will provide adequate erosion control and maintain undercut stream banks characteristic of good trout habitat."

This 30m buffer recommendation is given, citing no supporting studies, original data, or documentation. In fact, it is the only mention of a specific buffer size in the entire paper. This recommendation is repeated again in Robert Raleigh's 1986 paper, "Habitat Suitability Index Models and Instream Flow Suitability Curves: Chinook Salmon", which is the second reference listed in Figure 1. Again, this was the only mention of a specific buffer size in the entire paper. These two references are widely cited in papers that concern themselves with riparian buffers supporting evidence for a 30 meter buffer, and those papers are subsequently cited in other papers as justification for a 30 meter buffer.

Table 2. The six studies referenced in the Pleasant Valley Plan District Plan Chapter 6 as having been used to make decisions as to the appropriate buffer zones for preserving fish and aquatic habitat.

Study	What these studies say about buffers related to Fish and Aquatic Habitat.
Hickman and Raleigh 1982 (Terry Hickman & Robert Raleigh) Habitat suitability index models: cutthroat trout. U. S. Fish and Wildlife Service, FWS/OBS-82/10.5	This paper contains only one sentence concerning the width of a riparian buffer strip, and it is not supported by data or by citation: "In most cases, a buffer strip about 30 m deep, 80% of which is either well vegetated or has stable rocky stream banks, will provide adequate erosion control and maintain undercut stream banks characteristic of good trout habitat."
Raleigh et al. 1986 (Robert Raleigh, William Miller & Patrick Nelson) Habitat Suitability Index Models: Chinook Salmon. U. S. Dept. Int., Fish Wildlife Service. FWS/OBS-82/10.122	This paper is very similar to the previous, except for Chinook instead of cutthroat. This paper also contains only one sentence concerning the width of a riparian buffer: "In low to moderate gradient terrain, a buffer strip about 30 m wide on each side of the stream, 80% of which is either well vegetated or has stable rocky stream banks, provides adequate erosion control and maintains undercut stream banks characteristic of good salmonid habitat." The source of this information is unclear, it may be from (Chapman and Knudson 1980)[2] or from (Oregon/Washington Interagency Wildlife Conference 1979)
Knutson and Naef 1997 Knutson, K. L., and V. L. Naef. 1997. Management recommendations for Washington's priority habitats: riparian. Wash. Dept. Fish and Wildl., Olympia. 181pp.	Knutson and Naef review other some 1,500 studies including all those show in Figure 1. They make some limited buffer size recommendations, based on stream type as defined by Washington law WAC 222-16-031, and they have also added some of their own criteria for defining stream type. Current Washington law classifies streams based on the number of persons using the resource, the size of drainage, channel width, depth, fish usage, gradient, and whether it is perennial or seasonal. An older law was in effect at the time this paper was written that also used channel width in determining stream type. In Knutson and Naef, and in WAC 222-16-030, stream flow is considered only as "perennial" v. "intermittent" factor. Thus any tiny trickle of water that persists through the summer qualifies a stream as "perennial", which is not

[2] This paper makes no mention of stream buffers at all.

	adequate for describing the quality of fish habitat. In these classification systems, Kelley creek is considered fish habitat due to the presents of trout in what ODFW's call's reach #8 (a 459 meter long segment of stream high up along SW Rudlund Rd which may be a perennial reach of high quality habitat). Hickman and Raleigh (1982) state "There is a definite relationship between the annual flow regime and the quality of trout habitat", and that a stream such as Kelley Creek where the base flow is <25% of the average daily flow would be considered "poor for maintaining quality trout habitat". Kelley Creek has periods of very low flow (< 1.0 CFS) for periods of 3 to 6 months of the year. Stream width is a parameter that needs to be applied with caution, particularly in the case of degraded streams such as Kelley Creek. Poor land use practices including, live stock and off road vehicles in the stream bed, and intentional damming and ponding of the creek, removal of riparian vegetation, and increased siltation, have made the channel wider and shallower than what it would be naturally, or what it should be if managed as fish habitat given the available summertime flows. For the middle portion of Kelley creek using the ODFW observed stream widths of 1.3 to 4.4 meters, and applying this to the criteria presented in Knudson and Naef, you would conclude that the middle portion of Kelley Creek is a "Type 3 stream; or other perennial or fish bearing streams 1.5-6.1m wide", and should warrant a buffer width of 200'. However, in it's pre-settlement condition, the stream was likely much narrower, and probably would have fallen into the Knudson/Naef category of a "Type 3 streams; or other perennial or fish bearing streams <1.5m wide", and would therefore warrant an buffer of 150' using these criteria.
Eaman[3] et al. 1977 Don C. Erman, J. Denis. Newbold, and Kenneth.B. Roby. 1977. Evaluation of streamside Bufferstrips for Protecting Aquatic Organisms.	This paper provides the best evidence of any cited in the PVPDP for recommending a 30m buffer strip. Authors found significantly less diversity of insects in logged v. buffered streams. Insect density though was higher in logged streams, due to large increases in *Baetis* spp., *Nemoura*, Chironomidae. "Logging impacts were detected also in streams with buffer widths of less than approximately 30 meters. Streams with Bufferstrips wider than 30 meters did not display logging impacts. There was a direct correlation between increases in an index of diversity and increases in buffer width, and hence probably the degree of stream protection increased with buffer widths up to 30 meters."
Gregory et al. 1987 Gregory, S. V., G. A. Lamberti, D. C. Erman, K. V. Koski, M. L. Murphy, and J. R. Sedell. 1987. Influence of forest practices on aquatic production. Pages 233-255 in E. O. Salo and T. W. Cundy, eds. Streamside management: forestry and fishery interactions. Coll. For. Resour.	This paper discusses and presents some data from other studies related to buffers, particularly (Newbold et al. 1980). Newbold had measured macroinvertebrate density and diversity as a function of stream buffers that range in size from 0 to 60m. Gregory, Lamberti, Erman, Koski, Murphy and Redell make no specific recommendation as to buffer sizes, but rather say ; > There are no easy answers. There is no panacea. Effective management of riparian zones to minimize changes in aquatic ecosystems must acknowledge and incorporate the complexity and variability of natural systems. Appropriate management systems that take advantage of existing knowledge and identify critical areas for investigation require active cooperation, and communication between land managers, ecologists, physical scientists, and the public."

[3] A paper by the same author published 3 years after the cited study, also concluded that riparian buffers of 30m provide adequate protection from logging, (Newbold, Erman and Roby (1980).

Contrib. No. 57, Univ. Washington, Seattle.	
Castelle et al. 1992	This paper is mostly concerned with buffers to protect wetland habitat functions, and contains only a minimal discussion of the buffers needed to protect stream habitat functions. In the above Figure 1, Castelle is cited as recommending a buffer width of 200' for "Trout and salmon influence zone". This is not an accurate characterization of this paper. The only recommendation he makes specific to salmon states: "Studies which measured effectiveness according to environmental indicators, such as levels of benthic invertebrates and salmonid egg development in the receiving water generally found that 98-foot buffers adjacent to streams were effective." In the PVPDP Chapter 6 table 3 under the "Riparian and Upland Wildlife Habitat" function, Castelle is cited as recommending a buffer width of 450' to 600' for particular bird species. This is incorrect. Castelle does discuss other studies recommending these buffers, but in his summary and conclusions section, he states "In western Washington, wetlands with important wildlife functions should have 200 to 300-foot buffers based on land use".

Standard recommended Riparian Habitat Area (RHA) widths for areas with typed and non-typed streams. If the 100-year floodplain exceeds these widths, the RHA width should extend to the outer edge of the 100-year floodplain.

Stream Type	Recommended RHA widths in meters (feet)
Type 1 and 2 streams; or Shorelines of the State, Shorelines of Statewide Significance	76 (250)
Type 3 streams; or other perennial or fish bearing streams 1.5-6.1 m (5-20 ft) wide	61 (200)
Type 3 streams; or other perennial or fish bearing streams <1.5 m (5 ft) wide	46 (150)
Type 4 and 5 streams; or intermittent streams and washes with low mass wasting* potential	46 (150)
Type 4 and 5 streams; or intermittent streams and washes with high mass wasting* potential	69 (225)

*Mass wasting is a general term for a variety of processes by which large masses of rock or earth material are moved downslope by gravity, either slowly or quickly.

Figure 2. Stream type criteria and the recommended Riparian Habitat Areas associated with them. (From Knutson and Naef,

CONCLUSIONS:

The Fish and Aquatic Habitat buffer zones used in the PVPDP are poorly supported by the references cited within the PVPDP. Further, some of the references are quoted incorrectly in the PVPDP. In ETC's opinion, there is sufficient reason to request a review of the criteria used by the PVPDP.
Further, the fixed width buffer zone is a somewhat outdated management strategy. More recent authors, and, in some cases, the more recent writings by authors cited in the PVPDP, advocate a variable width buffer. In the recommendations section, we introduce the concept of a variable three-zone urban buffer system.

The literature is lacking in studies that correlate fish densities to buffer size in disturbed areas. To perform such a study, you would require dozens of comparable streams, then subject them to differing buffer treatments and measure the resulting impacts to fish populations. Because fish populations are affected by things happening a large distances from them, such studies would have to perform buffer treatments on a drainage wide basis to produce valid results. It is difficult to find two different streams that are similar enough to be considered comparable, let alone the dozens of comparable streams it would take to make a scientifically defensible study. It is even less possible to manage such a study in the real world of competing interests and political powers.

However, it is possible to measure other functions that riparian buffer strips supply, namely shading, cover, nutrients, temperature, organic litter, primary productivity, insects, water filtration, supply of LWD, (etc), as a function of stream buffers. These effects can often be observed within relatively small stream reaches. A number of studies have done this and produced useful measurements that correlate one or more of these functions with buffer size.

Researchers making fish buffer size recommendations have generally attempted to synthesize these studies, and run into problems trying to cobble together collection of different studies measuring different things at different times in different places, and then trying to conclude that, generally, a buffer of such and such a size will adequately protect a particular species of fish. Now we see in the literature a few papers making somewhat unsupported statements such as "a buffer strip of 30m is generally adequate to protect fish habitat". We then see this statement repeated in other papers, and eventually we have a long list of studies all repeating this result. The urban planner then looks at these results and says, "well, I've got all these references, and they all say about 30m will provide adequate protection. Lets go with that". When in reality, this planner is probably looking at an unsupported recommendation that has been repeated and sometimes even misquoted in a number of papers.

Table 3 Compares riparian buffer recommendations and management plans from jurisdictions and agencies. In general, the Oregon and Washington forest management plans use a three zone approach, where a 25 to 50 inner zone leaves the stream banks undisturbed. The middle and outer zones are selectively logged, while keeping tree stand densities within prescribed limits, and also leaving the larger trees standing. The Portland Metro and the US EPA recommended ordinances would require a 100' minimum buffer, though the EPA plan allows for more uses within the buffer. The Oregon "Safe Harbor" minimum buffer is the smallest of any reviewed. The PVPDP and Clark County ordinances require a 200' buffer, and are the largest of any reviewed.

Most jurisdictions prohibit new construction within the 100 year flood plane, whether this is stated in their habitat protection plan or in other building ordinances. Also, most jurisdictions provide some for of relief to owners of parcels who acquired their land before the ordinance came into effect. The PVPDP is similar to Metro's and Clark County's ordinance in this respect, where new construction is allowed within a habitat conservation zone, when the land owner has no alternative for building outside the zone. In such cases, the ordinance requires the construction to be as far away from the stream, and as close to the outer edge of the HCZ as possible.

Table 3 COMPARISON OF RIPARIAN BUFFER ZONES FROM DIFFERENT MANAGEMENT PLANS.

Managed Type area	Pleasant Valley Plan District Plan	Oregon NW Forest Management Plan[2]	Washington Forest Management plan (Western)[3,4]	Clark County Habitat Conservation Ordinance	Portland Metro Council of Governments[5]
Stream like Kelley Creek (Small, perennial low gradient fish bearing with sensitive species) that is being converted from agricultural to residential use.	200' buffer zone for streams containing sensitive species. Exceptions for small lot owners.	25' Stream Bank Zone – no disturbance allowed without permit. 75' Inner RMA Zone – Restricted harvest and machinery. 70' Outer RMA Zone 170' Total	50' Core zone, no harvest. 43' Inner zone, thinned to meet stand requirements, 47' outer zone thinned to 20 trees/acre. 140' Total RMZ	Consultation with WDFW required. Type "F" stream, Riparian Priority Habitat (RPH) is the greater of 200' or the 100 year floodplain zone.	Greater of the flood plain OR if woody vegetation absent then 50', if shrubs but not LWD then 100', if a LWD then 150'. Also includes any identified habitat of concern.
Large size stream (assume low gradient)	200' buffer (large streams would likely contain sensitive species)	Same	50' Core zone, no harvest. 55' Inner zone, thinned to meet stand requirements, 35' outer zone thinned to 20 trees/acre. 140' Total RMZ	Type S stream, RPH = 250' or the 100 year floodplain zone.	Same as for Kelley creek
Small perennial fish bearing high gradient streams	Gradient doesn't matter. 200' buffer	Same	Site class would probably be lower, and a larger RMZ would probably apply.	Gradient doesn't matter. Same as for Kelley Creek.	If Riparian class I then 200'. If Class II then depends on if the area is developed.[6]
Small perennial non fish bearing stream	50' buffer	Same, but higher harvest level allowed in Inner and Outer RMA zones	A 50' no harvest buffer would extend up to 500' from the confluence with a type S or F stream.	Type Np stream, RPH is the greater of 100' or the 100 year flood zone.	If it was rated as Riparian Class II, then see note #6. If it was rated as Class III, then the regulation does say if it gets a buffer at all.
Small seasonal streams Low gradient, non fish bearing.	50' buffer	Fewer restrictions on equipment outside of stream bank zone	30' zone where some restrictions on equipment may apply.	Type Ns stream, RPH is the greater of 75' or the 100 year floodplain.	If Class II then see note #6. If Class III then uncertain.
Wildlife corridor or buffer if applicable	Vegetation within 100' of stream	None`	None	Unclear	Unclear.
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TABLE 3 CONTINUED.

Managed Type area	EPA 3-Zone Urban Stream Buffer System Model Ordinance	Oregon "Safe Harbor" default buffer. (OAR 660-23-020).	Clackamas County (ZD0 704.04)	City of Gresham (Section 5.0600 – WQRA Overlay District)	
Stream like Kelley Creek (Small, perennial low gradient fish bearing with sensitive species) that is being converted from agricultural to residential use.	Minimum buffers: 25' Inner zone 50' Middle zone 25' Outer zone 100' Total.	50 feet	50 to 150 feet from bank full width depending on soils, slope, vegetation, type structure, width of river, (etc).	Primary streams drain > 100 acres. If primary then 50 feet from bank full width. Secondary streams drain 50-100 acres. 15 feet if secondary.	
Large size stream, (assume low gradient)	Minimum buffers: 25' Inner zone 100' Middle zone 25' Outer zone 150' Total.	75 feet for streams with > 1000cfs average annual flow. Otherwise 50cfs.	100 to 150 feet from bank full width depending on soils, slope, vegetation, type structure, width of river, (etc).	Most likely primary. 50 feet from bank full width.	
Small perennial fish bearing high gradient streams	Minimum buffers: 25' Inner zone 50-150' Middle zone 25' Outer zone 100-200' Total.	50 feet	50 to 150 feet from bank full width depending on soils, slope, vegetation, type structure, width of river, (etc).	If gradient > 25% then 200 feet if a primary stream, and 50 feet if secondary stream.	
Small perennial non fish bearing stream	Not defined	50 feet	50 feet	50 feet. All perennial streams are primary.	
Small seasonal non fish bearing streams	Not defined	Not defined	50 feet	50 feet if primary, 15 feet if secondary.	

2. The FMP would prohibit most disturbances and the operation of machinery in the steam bank zone. Machinery and partial harvest is permitted in the RMA zones with restrictions.

3. The FMP allows owners of parcels of 20 acres or less not to have an RMZ, but may require the leave of 15% of the amount of the volume of timber that would grow if the area were a well managed mature forest.

4. The RMZ varies by site class in the Washington Forest Practices Act. Assume a site class "3" for the sake of comparison with other plans

5. Metro's ordinance is complex, and the values shown in this table only apply to generalized circumstances.

6. Riparian Class II areas receive a 50' buffer in developed areas, and a 200' buffer in undeveloped areas.

RECOMENDATIONS:

Several important management plans recommend a variable width riparian buffer zone. These include The Riparian Management Guide for the Willamette National Forest, The Riparian Reference Guide for the Chippewa National Forests in Minnesota, and the EPA recommend a variable width riparian zone;

"For optimal management of riparian resources, riparian management zones should have variable widths that are delineated at ecological boundaries, not at arbitrary distances from the stream, lake or wetland. Riparian areas are naturally irregular or asymmetrical in shape, in response to local topography, geology, groundwater, and plant communities. Consideration of topographic irregularities can both protect riparian resources and simplify project design. Straight, uniform riparian management zones resembling picket fences should be avoided. Unique riparian resources, such as small springs, seeps, osprey nest trees, or sites of active beaver use frequently exist outside standard/average riparian management boundaries. In these instances, managers should consider modifying boundaries to include such areas. Delineating the boundaries of the riparian management zone will largely determine the effectiveness of subsequent management in meeting riparian objectives", (McKee, 1996).

The buffer widths should follow natural landscape features that shape the riparian processes ---hillslopes, floodplains, channel meanders, wetlands, significant forest stands, rock outcrops---as well artificial features---built structures that cannot be moved but almost totally eliminate riparian functions (e.g., buildings, parking lots, malls, etc). Sometimes people take the term "variable width buffers" to mean that you can vary the width from the intended width to lesser widths. This whittles away at the function and intent of the buffer. When we advocated variable width buffers, we meant buffers that roughly average the intended width but vary in width according to the stream, floodplain, and landscape features, (Gregory, personal communication).

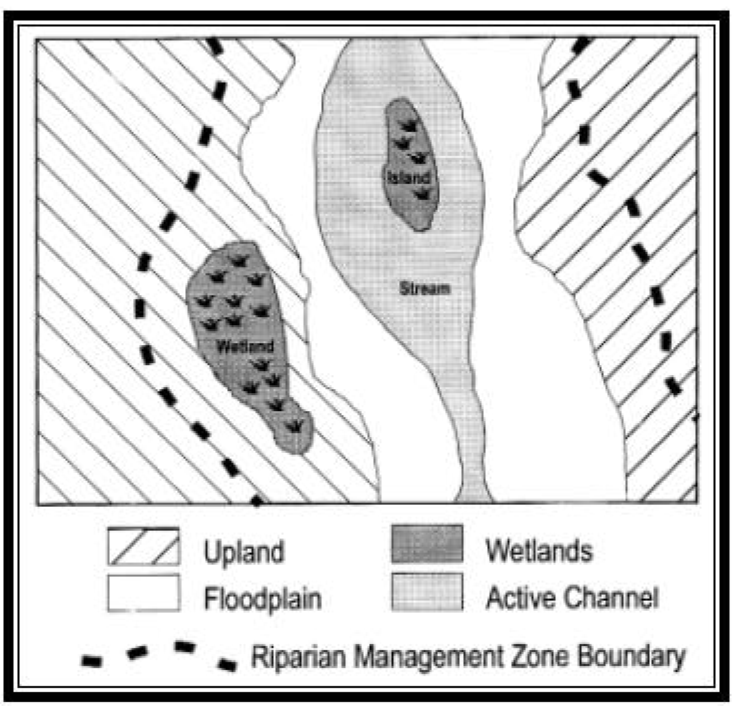
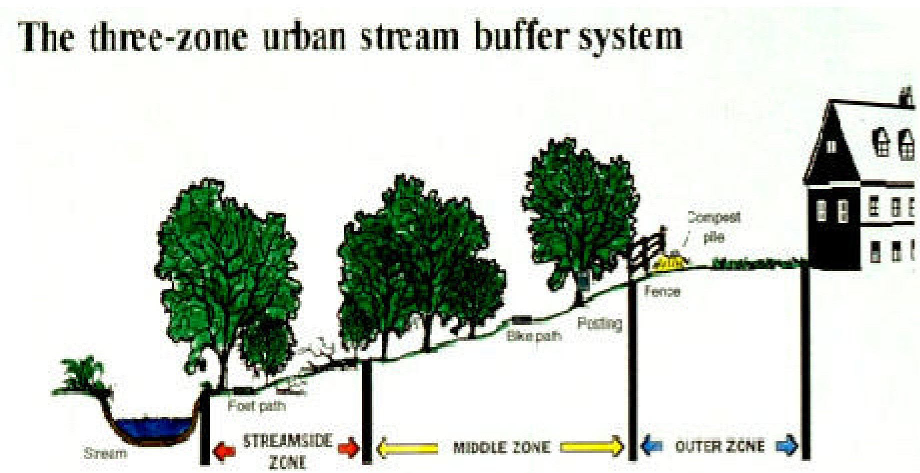


Figure 3. Riparian management zones along streams should have variable widths in order to protect complex channel structure and unique riparian resources. The entire floodplain should be included as well, (McKee, 1996)

The term vegetated buffer is currently used in many contexts, and there is no agreement on any single concept of what constitutes a buffer, what activities are acceptable in a buffer zone, or what is an appropriate buffer width. In one usage, the term vegetated buffer refers to natural riparian areas that are set aside or restored to filter pollutants from runoff and to maintain the ecological integrity of the water body and the land adjacent to it (Nieswand et al., 1989). In another usage, the term refers to constructed strips of vegetation used in various settings to remove pollutants in runoff from a developed site (Nieswand et al., 1989). USEPA (1996a) referred to vegetated buffers as barriers of natural or established perennial vegetation managed to reduce the impact of development or pollution on the water quality of adjacent areas. Vegetated buffers reduce the velocity of surface runoff and provide an area for infiltration of runoff into the soil. Finally, the term vegetated buffer can be used to describe a transition zone between an urbanized area and a naturally occurring riparian forest (Faber et al., 1989). In all these contexts, buffers can provide value to wildlife, as well as aesthetic value, (EPA, 2005).

A recent approach used by several municipalities, and advocated by the EPA, is the three-zone urban stream buffer system, (Figure 4).

A fundamental aspect of the three zone system is that it recognizes that not all regions of the riparian zone need to be treated the same. It further recognizes that the widths are variable, and can be expanded from the minimums shown in Figure 4 to include critical habitats as needed. The minimum 25' closest to the stream rates the highest protection, as this section is critical for maintaining bank stability, vegetative cover, (etc). Low impact incursions are permitted such as foot paths leading down to the stream from the main path. The widest portion, the middle zone, is mostly vegetated, but allows such things as bike paths and recreational use. Using the EPA guidelines, the minimum width for the middle zone is 50 feet, and this can expand to 100 feet depending on slope, topography, sensitive areas, and stream size. And finally, the outer zone can be used for yards, ball parks, (etc), as long as the use does not cover the ground with an impermeable surface such as a structure or paved parking lot. It's minimum size is 25 feet.



CHARACTERISTICS	STREAMSIDE ZONE	MIDDLE ZONE	OUTER ZONE
FUNCTION	Protect the physical integrity of the ecosystem	Provide distance between upland development and streamside zone	Prevent encroachment and filter backyard runoff
WIDTH	Min 25 feet plus wetlands and critical habitats	50 to 100 feet, depending on stream order, slope and 100 year floodplain.	25 foot minimum setback to structures
VEGETATIVE TARGET	Undisturbed mature forest. Reforest if grass	Managed forest, some clearing allowable	Forest encouraged but usually turfgrass
ALLOWABLE USES	**Very Restricted** e.g. flood control, utility right of ways, footpaths, etc.	**Restricted** e.g. some recreational uses, stormwater BMPs, bike paths, tree removal by permit.	**Unrestricted** Residential, lawn, garden compost, most stormwater BMPs

Figure 4. Three-zone urban stream buffer system, adapted from EPA Model Ordinances to Protect Local Resources, (EPA 2006) and the Storm Water Manager's Resource Center, (2006).

Thus the minimum width of the three-zone urban stream buffer system is 100', and this value is supported by a large body of scientific literature. Adopting these guidelines would likely[4] apply a 100' riparian buffer zone to the middle and upper portions along Kelley Creek, and probably a 150' to 200' buffer to the lower stretch of Kelley Creek.

Channel Migration Zones. The ESRA delineates riparian habitat zones starting at the edge of the channel migration zone, which are identified largely using aerial photographs. This has the potential for creating significant errors, particularly densely vegetated areas. At a minimum, ETC recommends the channel migration zones be ground truthed for accuracy. We also note that other jurisdictions generally use the top of the active channel to define the edge of the stream, rather than the channel migration zone, which tends to be wider. Given that urban streams are seldom allowed to stray far from whatever channel was in use at the time the surrounding area was developed, considering historic channels as part of the stream bed probably is not a constructive activity.

100 Year Flood Deliniation. Most jurisdictions do not permit new construction within the 100 year flood plane.

KELLEY CREEK HABITAT MANAGEMENT RECOMENDATION:

Kelley Creek and it's tributaries are all small first and 2nd order streams. Flows tend to be very flashy, ranging from a trickle in the summer to relative torrents of 200 cfs in the winter.

At the present time, much of Kelley Creek, and it's tributaries can only be described as heavily impacted and degraded habitat. Siltation and stream widening from poor land use practices, damming and ponding, removal of riparian vegetation, not to mention the very low summer time flows, explain the relatively low abundance of fish observed in ODFW surveys. For the most part, we are not working with a stream that needs to be preserved, but rather one that needs to be restored.

A comprehensive restoration plan for Kelley Creek should seek to narrow and deepen the stream bed, identify and develop refugia for fish to survive the flashy winter time flows, and to survive the summertime periods of low flows and high temperatures.

Riparian vegetation should include enough shading to control summertime heating of the streams. Several authors recommend the canopy cover should be about 80%. This figure is derived from studies that found algae to become light saturated at around 20% of full strength sun light, and additional amounts of light do not result in greater primary productivity in shallow streams. Thus an 80% canopy cover is thought to provide a good balance between optimizing photosynthesis and maintaining cooler temperatures by shading. A refinement of strategies to optimize the balance between sun and shade may be to plant the south bank with taller trees, and leave the north bank more open with grasses and shrubs. This would allow indirect light for photosynthesis.

The literature does not provide much guidance for exactly which plant species should be used to optimize a stream for trout habitat. In general though, leaves of deciduous plants break down much more readily than do coniferous needles, and therefore tend to release more nutrients faster than do coniferous trees. Insect populations benefit from this, and (in theory) trout populations should therefore benefit from deciduous trees as well. Because deciduous trees drop their leaves in the fall, this also tends to benefit primary productivity in the stream bed during the winter and early spring.

Areas of high quality upland habitat should be incorporated into habitat conservation areas. Buffer averaging can be used to increase the buffers in these areas, while reducing it areas that do not provide significant habitat value.

[4] ETC has not done a comprehensive study of Pleasant Valley, and so can not at this time state with any certainty that there are not circumstances present (such as steep slopes, sensitive areas, (etc)) where a greater buffer would be appropriate using these recommendations.

Base buffers on best available science with a minimum buffer of 90-100' (EPA, Metro, (etc). Buffer reduction of ½ of base buffer wideth of 200' to be granted with buffer mitigation to standards cited in the above items.

The vegetative corridor should be restored with a multi-layered vegetative strata composed of high quality wildlife food and cover plants. Both deciduous and coniferous plants for maximum utilization by wildlife as cover, a corridor, and for forage.

RESOURCES – SOME LINKS TO MORE INFORMATION:

State of Washington Best Available Science -
http://cted.wa.gov/_CTED/documents/ID_874_Publications.pdf

EPA recommendations of 5 municipal ordinances to review for designing an ordinance concerning riparian buffer zones. Note that Portland Oregon is one of the references listed.
http://www.epa.gov/owow/nps/ordinance/osm1.htm

EPA Model Ordinance. Environmental Protection Agency, Washington, DC, Office of Water, 2006
http://www.epa.gov/owow/nps/ordinance/mol1.htm

Shoreline Vegetative Buffers. A good generalized discussion on buffers, and has some great links for further information: http://www.muskoka.on.ca/planningeconomic/Buffers.pdf

Storm Water Manager's Resource Center
http://www.stormwatercenter.net/

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