9 CHANNEL MODIFICATION ASSESSMENT

INTRODUCTION

A channel modification is a human-caused alteration that influences channel geomorphology and often disrupts biotic function. Direct modifications include channelization, dams, roads, bridges, riprap, ditches, culverts, instream mining, dredging, levee building, and other bank stabilization efforts. Channel disturbances can move a stream from its natural channel, affect water velocities, change sediment transport relationships, reduce available habitat for aquatic organisms, and change water temperature. In addition, the effects of channel modifications may often cause geomorphic adjustments that may impact a given channel for significant distances, both upstream and downstream of the original action. This is often observed, for example, with actions that initiate a geomorphic response that includes channel incision or downcutting. Further, once channel instability is initiated, the area of disturbance can then propagate downstream as the excess sediment from bed or bank erosion is deposited in downstream reaches causing additional instability and habitat impacts. Identification of these indirect, off-site effects of channel modifications is often difficult.

The purpose of this chapter is to identify current and historic channel modifications in the upper Williamson River subbasin, including both public and private lands, to the extent feasible.

The Channel Modification assessment methodology outlined in the *Oregon Watershed Assessment Manual* (WPN 1999) is designed around a series of critical questions that form the basis of the assessment. These critical questions are:

1. Where are channel modifications located?
2. Where are historic channel disturbances, such as dam failures, splash damming, hydraulic mining, and stream cleaning, located?
3. What channel habitat types have been impacted by channel modification?
4. What are the types and relative magnitude of past and current channel modifications?

METHODS

Data on the location, timing (mostly not able to be identified), and nature of channel modifications were gathered from a variety of agencies and sources, but primarily from the USFS watershed analyses. Aerial photographs were examined and limited field reconnaissance was conducted.

RESULTS

The upper Williamson River has a long history of human activity. By the 1860s, stockmen had been utilizing the watershed, starting a legacy of ranching that continues today. In the 1880's, the first irrigation systems were installed to increase the grazing potential of floodplain areas along the mainstem and lower portions of significant tributaries. Road building and timber harvest occurred in the watershed. These activities have affected channel conditions in a number of ways. The following discusses some of the more obvious channel modifications and their impact to channel and aquatic habitat conditions.

Perhaps the most significant "modification" to channel conditions over time has been an indirect result from the specific actions detailed below. Changes to overall channel condition have been brought about by a combination of land management activities in the watershed. This issue is addressed in the Discussion section.

Locations of Channel Modifications and Disturbances

Almost all channel modifications are located in low gradient, alluvial reaches of the upper Williamson River and its major tributaries, and in the vicinity of the Klamath Marsh (see Map 4-1). Since virtually all of the channel modifications have occurred in the low gradient alluvial reaches, the impacted channel habitat types are primarily C and E channel types.

Limited information was developed on historic channel disturbances. References to one splash dam were found, otherwise no other information on dam failures, splash damming, hydraulic mining, or stream cleaning was found. Riparian vegetation has decreased significantly along the upper Williamson River upstream of Klamath Marsh, probably as a result of extensive grazing.

Types and Magnitude of Modifications

Channel modifications in the subbasin include:

- Modifying the Klamath Marsh, including road construction, channelization, potential modification of the hydraulic control of the marsh, and canal construction intended both to facilitate seasonal draining of wetlands or irrigation for agricultural purposes
- Installing roads, culverts, and bridges across streams
- Installing railroad grades along and across streams and meadows
- Splash dams
- Instream dams and ponds
- Water diversions and ditch construction
- Removal of woody debris and riparian vegetation
- Instream Habitat Projects and Riparian Fencing

Alteration of the Klamath Marsh: Although quantitative data on the extent of modification of the Klamath Marsh is generally lacking, there is general agreement that significant alterations of the Marsh have occurred since the early 1900s. Some documents have indicated that the hydraulic control of the marsh was greatly altered around 1910 by blasting. One document (USFS 1996) suggests that this caused as much as 5 to 10 feet of change in the elevation of the control at Kirk Reef, although other accounts suggest that any blasting at Kirk Reef would not have had any impact. In any case, GLO maps and other historic descriptions of the area indicate a much more extensive marsh, with up to 10,000 acres of open water wocus habitat (Colville 1902). The river channel in the portions of the marsh has been dredged and straightened, and drainage/irrigation canals have been built to modify the hydrology of the marsh and vicinity to better accommodate agriculture. It has been hypothesized that channel modifications on the east side of the marsh may have initiated a headcut that has migrated as far upstream as Rocky Ford, causing channel incision and instability (USFS 1998, Dunsmoor, pers. comm. 2004). Lack of quantitative data, such as surveyed long profiles of the river and its floodplain, precludes definitive evaluation of such theories.

Channelization: This modification involves channel straightening, relocation, and excavation and has occurred throughout the subbasin. For example, the Williamson River historically spread over a wide delta when it entered Klamath Marsh, but the natural channel has been diked and diverted to supply water to drier portions of the marsh (La Marche 2004a). Channelization was done for a number of reasons, including water delivery for irrigation purposes, seasonal draining, and realignment to ease agricultural operations. The data source for identifying these channels are existing digital coverage obtained from TNC and USGS, it is highly probable that additional reaches of channelized streams occur in the watershed, particularly short reaches too small to appear on the map. Channelization has occurred over the last 80 years, with the precise dates of most of the work unknown. Channelization has a direct effect on habitat conditions in the affected reach. Simplification of aquatic habitat is the primary impact, as the stream structure that produced pools, riffles, and steps is removed. In addition, downstream reaches can be affected as flow velocities increase and sediment delivery rates and timing are altered. Channelization and channel simplification can also cause significant bank erosion.

Road Construction: There is little information on the extent of channel modification caused by road construction in the basin, although thousands of miles of roads have been built in the watershed (see Chapter 8), and at least 3.5% of these roads are located within 200 feet of a stream channel. Some roads, like Military Crossing Road, and Silver Lake Highway, may affect channel function by concentrating surface flow towards a few points of crossing over the affected floodplain (Dunsmoor pers comm. 2004).

Railroad Construction: There are over 700 miles of historic railroad grades in the watershed, with most constructed in the 1910 to 1935 period, when most timber harvest was conducted via railroads (USFS 1996). Numerous spurs were constructed along the tributary drainages along the east and west sides of the marsh. Few railroad grades were developed in the northern or eastern portions of the watershed. After 1940, most timber was hauled by trucks and many of the railroad grades were converted to roads. In places, such as Skellock Draw, construction of railroad grades has been identified by USFS as having a significant impact on adjacent stream channels (USFS 1996), by constricting the floodplain and concentrating flow.

Splash Dams: A splash dam is a constructed impoundment used to store a large volume of water, that when rapidly released provides sufficient flow and water depth to float timber that has been stored in the impoundment to downstream areas, where it can be retrieved and hauled to mills. At least one splash dam (Williamson River at Williamson River Campground) has been identified in the watershed. Others probably were constructed and operated, although the nature of the land ownership (Klamath Tribal land), timber harvest history (large sales), and volume of water may suggest that there were relatively few.

Instream Dams and Ponds: A number of instream dams have been constructed, particularly in the upper mainstem above Sand Creek, for stock watering, irrigation, and to provide fishing areas. The overall impact to the aquatic resources of all of these structures are unknown.

Water Diversions and Ditch Construction: Many low gradient areas suitable for grazing (in and adjacent to the marsh, along the Williamson River, and in tributaries with meadow areas) have been impacted by water diversions and ditch construction. This has affected most of the significant tributaries to the river and the marsh, by reducing instream flows and spreading flows out to the extent that some channels do not reach the mainstem.

Removal of Woody Debris and Riparian Vegetation: The dense willow thickets between the marsh and Rocky Ford described in the GLO surveys have been largely eradicated by both active (removal) and passive means (grazing prevents recruitment). In recent years, riparian fencing is allowing some areas to begin to see the reestablishment of woody vegetation.

Instream Habitat Projects and Riparian Fencing: A variety of public and private partners have been undertaking instream habitat projects, riparian planting, and riparian fencing in the assessment area since at least 1973 (USFS 1996). Quantification of the impact of these improvements on channel morphology and aquatic habitat is not possible. In most cases, the impact of the fencing and structures has not been monitored, and only a qualitative assessment concerning the impact can be made. Field reconnaissance suggests that riparian fencing is working in many areas that are showing signs of recovery.

Discussion

In general, channels that are most sensitive to changes are low gradient (<2%) reaches with a developed floodplain (Montgomery and Buffington 1993). These alluvial channels generally lack geomorphic controls such as bedrock, boulders, or confining terraces or hillslopes. Alluvial valley reaches in river systems often act as “response reaches,” since they are areas of temporary (in a time frame of decades to hundreds of years) sediment storage that adjust their storage and the stream channel geometry traversing these areas in response to changes in streamflow and sediment discharge. Thus, episodic events such as large floods may cause the channel location to change, sometimes dramatically, in response to the energy of high flows that exceed the resisting forces of the stream channel banks and riparian vegetation. In a similar manner, large influxes of sediment, whether derived in a single large storm event or delivered chronically over a longer time period, may cause changes in channel form in these response reaches as sediment deposition locally overwhelms the capacity of the channel to transport it. In the low gradient reaches of the upper Williamson River, channel form has adjusted to increased sediment loads, loss of bank stabilizing riparian vegetation, and channel modifications in several ways. In upstream reaches, primarily affected by increased sediment loads and bank erosion, the channel has widened, become shallower and increased its width to depth ratio, reducing aquatic habitat and sediment transport capacity. In downstream reaches more directly affected by channel modification, the channel has incised, widened, and become isolated from its floodplain.

Historic road construction, timber harvest and agricultural practices have significantly altered the marsh and river channel, both upstream and downstream. Unfortunately, virtually no data are available to quantify the extent or impact of these alterations. Quantification of historic changes to the Williamson River and the Klamath Marsh, to the extent possible, could help provide assessment of opportunities for restoration.

CONFIDENCE EVALUATION

Significant data gaps exist regarding the location and extent of channel modifications, and more importantly, regarding their relative impact on aquatic resources. As a result, confidence in the evaluation is moderate. Additional information from personal interviews with long-time property owners would help strengthen this Assessment.

RESEARCH RECOMMENDATIONS

1. Geomorphic Analysis to Quantify Impact of Channel Modifications and to Guide Restoration Options. A thorough geomorphic analysis of the Klamath Marsh and the mainstem Williamson River is suggested in order to quantify the extent and specific nature of the channel instability between Sand Creek and the marsh. With this analysis, specific recommendations for restoration could be developed and implemented.

2. Monitor the Effectiveness of Restoration Actions. While much has been done in the watershed to improve channel and habitat conditions, many of these efforts have not been monitored. Without monitoring, identifying and implementing those activities that yield the greatest benefit can not be done. This should begin with an inventory of those improvements that are already in place.

3. Light Detection and Ranging (LiDAR) Geomorphic Analysis. Lack of a solid geomorphic understanding of the streams and the marsh constitutes a significant data gap. Much of this data can be acquired using remote sensing techniques, including the use of LiDAR, which can yield a substantial amount of information in a GIS platform (Dunsmoor pers. comm. 2004).

RESTORATION OPPORTUNITIES

1. Restore Natural Geomorphic Processes. In the mainstem and lower reaches of larger tributaries, damage from loss of riparian vegetation and channel incision has combined to change the physical attributes of the stream, resulting in aquatic habitat degradation. Many streams have widened and become shallower, with a loss of pool habitat. Along the mainstem, the channel has downcut and become isolated from its floodplains. This is likely the case in certain tributaries also. Downcut channels and the associated loss of floodplain connectivity can reduce the amount of water stored in the soil profile by lowering the water table. (Section 5, Hydrology and Water Use, provides an in-depth discussion of the above mentioned processes) Through a combination of reducing sediment yields, specific restoration actions, as well as promoting riparian recovery, the geomorphic processes that control channel conditions will begin to improve aquatic habitat.