

About Dam Time!

The Emergence of Dam Removal in River Management Policy
Lessons from the Elwha River Restoration Project

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Abstract

Dams are pervasive features of the river systems in the United States. More than 80,000 large dams, and as many as 2.5 million small dams, are spread throughout every major watershed in the country. While this vast number of dams has made a considerable contribution to development, recognition of the environmental impacts has significantly increased. Furthermore, over 25% of the nation's dams are now reaching the end of their operational lives, facing physical deterioration, risk of failure, loss of economic viability, and expired federal contracts. The convergence of these environmental, economic, social, and regulatory concerns is reflected in the sudden, remarkable emergence of *Dam Removal* in river management.

Dam removal represents a fundamental transformation in river management discourse, yet has been rarely studied. Through exploration and description of the emerging concept of dam removal, this thesis contributes to the discourse on river management. The transformation is further illustrated through a study of a pioneering dam removal project currently underway on the Elwha River in the Pacific Northwest United States. This monumental project is the country's largest dam removal and most expensive river restoration ever attempted.

The evolution of the Elwha River Dam Removal project is representative of the broad shift in river management and also indicative of the significant policy issues that still exist around dam removal. Analysis of the phenomenon of policy change applied to the Elwha River case reveals factors of political receptivity, physical complexity, and advocacy coalitions that have been critical in the policy change process. From this case, policy lessons are found regarding the implications of congressional intervention in dam removal proposals, and the need for reforming hydropower dam licensing procedures in the Federal Energy Regulatory Commission. These specific policy lessons are valuable for the integration of dam removal in lasting river management policy.

Key Words Dam Removal, River Restoration, River Management, Policy Change, Elwha River

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1.0 Introduction

1.1 Problem Description

Dams are pervasive features of the river systems in the United States. More than 80,000 large dams and as many as 2.5 million smaller dams are spread throughout nearly every major watershed in the country (World Commission on Dams 2000). This vast number of dams has made a considerable contribution to human development, but has also caused severe environmental impacts to river ecosystems (Heinz Center 2002). There is now an increasing recognition of the value of healthy rivers for more than the simple functional utility of dams, but for providing important ecological and social services upon which society depends (Doyle 2000).

Spurred by this growing concern for rivers, the dispute between the development benefits and environmental impacts of dams has recently come to the forefront of academic and governmental discussion. Further intensifying the debate, in the United States, over 25% of the nation's dams are now reaching the end of their operational lives, facing physical deterioration, loss of economic viability, and expired federal operation contracts (FEMA 2002). The convergence of these environmental, economic and regulatory concerns, along with a shifting social environmental discourse is reflected in the sudden, remarkable emergence of *Dam Removal* in river management.

While the concept of dam removal was initially derided as an extreme and unreasonable environmental approach, it is increasingly seen as a viable ecological restoration tool to bring back the fundamental physical integrity to rivers (Graf 2001). The emerging idea that dams are not necessarily permanent features of the landscape, but can and should be removed, represents a fundamental shift in river management discourse, which has been rarely studied (Poff 2003).

Globally, dams and hydropower continue to play an important role in water, energy and sustainability issues, especially in the context of climate change. As supported by the *International Panel on Climate Change*, reliable and renewable hydropower production provides substantial development benefits, contributing 16% of worldwide energy supplies (IPCC 2011). However, the large social and ecological effects of dams documented by the *World Commission on Dams* and the *Millennium Ecosystem Assessment*, debate the IPCC's view of hydropower as a truly renewable energy source (International Rivers 2011). In the United States, hydropower has traditionally been a cornerstone of the nation's energy production, but recently it has diminished in national importance as the ecological effects have grown, dam infrastructures have deteriorated, and alternative renewable energy sources have improved (American Rivers 2010). Because of these factors, dam construction has significantly declined, few hydropower dams are likely to be built in the future, and a trend towards removal of obsolete dams has begun.

An impressive example of this transformation is visible on the Elwha River in the Pacific Northwest United States, where the country's largest dam removal and river restoration project is currently underway. The history of river management on the Elwha River and the evolution of the dam removal project are representative of the larger shift in river management, but are also indicative of the significant policy issues. The Elwha case is a pioneering dam removal project, which overcame many political and economic obstacles, however, lasting policy progress from this project has not been integrated into United States river management.

In the larger shift from river development and dams to river restoration and dam removal, a significant policy vacuum has been exposed in river management. While the Elwha River dam removal is an important illustration of this shift to river restoration, more specific policy change lessons can be learned from this case. Employing theories of policy change, such as the *Advocacy Coalition Framework* of Sabatier and Jenkins-Smith (1999) and applying them to the Elwha River Dam Removal reveals how fundamental policy change occurred in this case, and gives important policy lessons that can be utilized in other similar river management situations in the United States.

This study of policy change in the emergence of dam removal comes at an important juncture as a lack of organized river management entities has created a obvious policy vacuum, while deteriorating dam infrastructure and the shift in public environmental discourse, has created a favorable policy window (Pejchar 2001). As several trends are merging and increasingly leading river management towards dam removal, there is a significant opportunity for lasting policy integration of the concept.

1.2 Thesis Aims and Rationale

This thesis aims to contribute to the discourse on river management through an exploration of the emerging concept of dam removal. Secondly, this thesis aims to describe the significant factors in policy change, particularly related to the institutions involved in river management. Lastly, this thesis aims to provide specific lessons in policy change related to dam removal.

This research identifies a significant transformation in the social-ecological discourse around river management in the United States. This is demonstrated through a description of the evolution of river restoration in academia and government policy, followed by an exploration of the causes for the emergence of the dam removal concept. This aspect of the research seeks to compile the fragmented study around dam removal through literature analysis, which also acts as background for examination of policy change in river management.

The transformation in river management is being experienced through the cumulative effects of influential river restoration cases, such as the Elwha River Dam Removal project. The reference to the Elwha River case study is motivated by the intriguing history of the management of this river. The shift from traditional river development policies to the recent restoration and dam removal project is representative of the broader shift in river management and offers generalizations of the discussion to other similar situations. Furthermore, the Pacific Northwest region, where the Elwha River is located, is a leading producer of hydropower in the nation (Bender 1997), and the epicenter of the river restoration and dam removal movement, making significant and lasting policy change in river management likely to emerge from here.

The Elwha River case is a milestone in the transformation of United States river management policy and provides valuable policy lessons. The objective of the Elwha case study is to assess this important experience in dam removal to identify and evaluate the institutional and socioeconomic dimensions that shape policy change regarding dam removal. Impetus for the focus on policy change in river management came from recognition of the many debilitating policy disputes delaying river restoration and dam removal progress in the United States. While the ecological and economic aspects of dam removal are relatively well-studied, little attention has been given to the institutional policy issues associated with the removal of dams. These policy factors play a major role in the dam removal decision-making process.

While the concept is increasingly recognized as a viable river restoration tool, many dam removal proposals are still considered extreme, experimental and politically, rather than ecologically motivated. This difficult political debate is indicative of the policy vacuum and the lack of consistent organized entities involved in river management. The ineffective policy procedure, yet perseverance of the dam removal concept, became the incentive to direct research towards finding lessons for its lasting policy integration.

The focus on the practice of river restoration and dam removal is based on a firm foundation in the theory of restoration ecology. The *Society for Ecological Restoration* defines restoration as, 'the process of intentionally compensating for damage by humans to the biodiversity and dynamics of indigenous ecosystems by working with and sustaining natural regenerative processes in ways which lead to the reestablishment of sustainable and healthy relationships between nature and culture.' (SER 2000) This idea of restoration is present throughout the thesis as a guiding principal inspiring the research and justifying the basis for the study.

The focus on policy change in river management is based on a synthesis of theories. A simple definition of policy change is 'the replacement of existing policies via modification, reversal, termination, or adoption of new policies' Lowry (2003). A more nuanced understanding of policy change is utilized later to reveal how policy institutions and political venues fundamentally interact with river issues.

Rooted in these theories, this research holds believes in the genuine possibility and desirability of the realization of river *restoration* and *policy change* in river management. With nearly every major river in the United States blocked by thousands of rapidly deteriorating dams, research into the issue of dam removal and policy change in river management is both timely and prescient. To guide the research and fulfill the aims of the thesis, the following three research questions will be investigated.

1.3 Research Questions

- 1. What are the critical aspects and causes for the emergence of dam removal and the transformation in river management?**
- 2. What are significant factors involved in policy change and how are they present in the process leading to Dam Removal on the Elwha River?**
- 3. What lessons can be gained from the Elwha River case study to further the integration of lasting Dam Removal policy?**

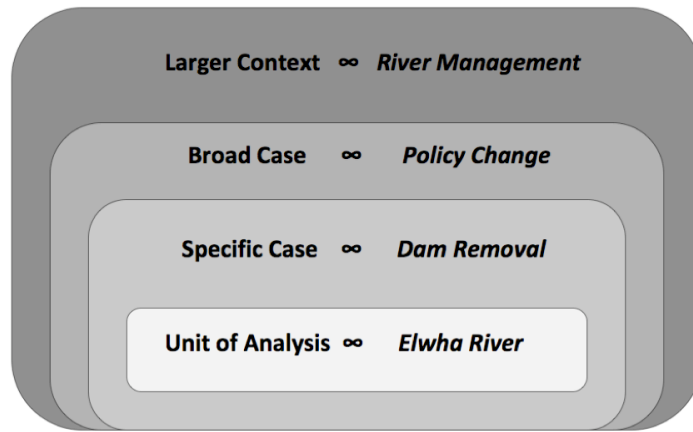
2.0 Research Methodology

This thesis conducts qualitative research from a constructivist model, in that it serves to explore social issues, understand related phenomena, and enhance comprehension of the problem (Mikkelsen 2005). The research employs a single case study design arising from the desire to understand a complex social phenomena, while retaining the holistic and meaningful characteristics of real-life events (Yin 2009). As supported by Schramm, 1971, 'The essence of a case study, is that it tries to illuminate a process or set of decisions, why they were taken, how they were implemented, and with what result.' (Schramm 1971)

The motives of using a case study were to give description to an important individual case and also to arrive at broad generalizations based on the evidence of this case. The research process began with a thorough analysis of river management literature, using an historical research strategy, relying on primary documents, secondary data, and cultural archives as the main sources. This historical approach allowed the research to reflect retrospectively on the history of contemporary cases in the context of present conditions (Silverman 2010).

Initial literature analysis led to the raising of generative questions, which became more focused by identifying linkages to the core theories of restoration and policy change. This theoretical development facilitated the data collection phase and also dictated the level at which the analytical generalizations of the case study results would occur (Yin 2009). The reference to policy change theory made the research a descriptive case study, rather than an exploratory case study, in that it gave specific direction to the data collection and case description. While there are various approaches to the context of river management in the United States (i.e. ecology, economy, engineering, etc.) this research comes from the angle of policy making.

The research in this thesis is structured following Yin's (2009) design of a *Single Embedded Case Study* (see figure 1). First, the context of river management discourse is examined; second, the case of policy change is treated as a theoretical phenomenon; third, dam removal is investigated as a case of policy change; and lastly, the Elwha River Dam Removal project is used as the embedded unit of analysis. The Elwha River is adopted as the unit of analysis because it provides policy perspectives from various institutional levels. This thesis holds the methodological view supported by Flyvberg (2001), which sees the single case study of the Elwha River Dam Removal project as important for generalizing beyond this particular case. Research data was collected through a synthesis of literature analysis, participant observation, and informal interview (Bryman 2008).



source: adapted from Yin (2009)

Figure 1. Single Embedded Case Study Design

2.1 Methods - Literature Analysis

This research stems from the recognition that river management is generally understudied and that the concept of dam removal is a relatively unknown. Considering the diversity and magnitude of river management issues, literature in this arena is fragmented and insufficient. This motivated a thorough literature analysis in an effort to coordinate information towards describing the policy aspects of the emerging dam removal concept. This facet of the research was not meant to replicate prior research findings; rather it is used as background development to fulfill the central aims of the thesis (Yin 2009).

Initial literature research led to the *Clearinghouse for Dam Removal Information*, which is a newly established web library of pertinent authors and studies in the field. In combination with searches from Lund University's LibHub server, the research selected the most relevant institutions and literature around dam removal. Using a wide sample of existing literature sources, the analysis identified conceptual and relational themes, then categorized the literature into the mediums where the concept of dam removal occurs: *project descriptions, academic discussion, government policy, and public awareness*.

Analysis of web archives of prominent River advocacy networks and major newspapers was used to gauge public awareness of dam removal issues. Material was also compiled from reports in the Federal Energy Regulatory Commission (FERC), which oversees many dam removals. These reports outline their mandated policy processes and were used to determine the advocates and opponents of various dam removal projects. Quantitative studies were also found here, documenting the chronological increase in the occurrence of dam removal projects and the geographic orientation of these projects in the United States. The most historically significant dam removals were isolated and researched further.

A keen theoretical sensitivity was required to analyze all the variables and relationships in the literature around river management. Literature analysis was an effective process for utilizing the wide scope of existing data and extending the scope of the research (Silverman 2010).

2.2 Methods - Interviews and Observation

Fieldwork consisted of informal interviews and participant observation around the Elwha River dam removal project. Prior to entering the field, literature analysis and consultation of newspapers and media was conducted to get a realistic understanding of the background and key policy aspects of the case.

While this initial study had the potential to desensitize the research through creating preconceptions, it was necessary for conducting participant observation, which requires an established basic understanding of a case (Yin 2009). Familiarity with the topic allowed for more informed participation in unstructured, open-ended dialogue for an accurate sense of the case. During interviews, it enabled interaction from a more embedded personal stance and gave freedom to move interviews in any direction to explore the topic broadly (Silverman 2010).

In site visits to the Elwha River Dams, the aim was to gather first hand information about the dam removal project in a naturally occurring context (Bryman, 2008). Informal interviews were conducted with two managers of the dam removal project from the Olympic National Park Service where the dams are located, as well as two employees at the hydropower dams and a photojournalist documenting the project. No transcribing or indexing was established, as the interviews were informal and used to inductively assess the Elwha River Dam Removal policy process rather than systematically categorize responses. Information was synthesized across respondents to accurately infer their general positions.

The participant nature of the observation and interviews allowed for unusual and exclusive access during the field visits. I was given special entrance to view the Elwha dams and hydropower facilities just days prior to the shut down of access to the entire watershed for initiation of the dam removal demolition process. Witnessing the controversial dams just before this monumental restoration project was to begin was a unique opportunity, and gave valuable insight for describing the case (Yin 2009). These field research experiences are present throughout the description of the Elwha case, and although not quoted directly, they act as a strong supplement to the extensive observation and documentation I conducted.

2.3 Limitations of the Research

Main limitations in this research involve that of literature analysis, case study design, generalization of analysis, and biases. This thesis attempts to synthesize the fragmented literature to describe the emerging concept of dam removal, however, due to the variety of disciplines and approaches, it could not possibly review the entire breadth of work on this topic. Furthermore, in analyzing river management policy change, judgments are inherently present, as this thesis cannot fully grasp the dogmatic political character surrounding dam removal issues.

The limitations of case studies and participant observation should be acknowledged for the potential of informal manipulation of evidence and biases influencing the findings (Yin 2009). Single case studies are not a representative sample and can be limited in their ability to generalize theoretical propositions (Silverman 2010). While there are many dam removal cases in the country, which could provide for an interesting multiple case study design, the single Elwha River case is valuable as it has pioneered the concept of dam removal. As this setting is unique, the policy lessons attained from the Elwha River are applicable to other cases in the United States.

Although the increase of river restoration projects in the United States is evidence of a general consensus in the theoretical foundations of ecological restoration, many are still skeptical of the value of dam removal, and the role of the concept in larger socio-ecological sustainability. Dam removal projects continue to face theoretical and political questioning, inherently part of the early stages of policy change. Merely conducting research into the policy integration of dam removal implies that this thesis opposes this theoretical questioning; rather, it sees the emergence of dam removal as an important aspect of larger ecological restoration goals.

The necessity and desirability of river restoration are assumed to be the underlying reason for the current transformation of river management and for the policy changes taking place around dam removal. While the notion of conducting impartial research is generally adhered to, a genuine interest and concern for these issues may give bias to the research. However, a foundation of genuine interest is fundamental to the achievements in the research.

3.0 Transformation in River Management

The United States is currently experiencing a significant shift in approaches to river management policy. Rivers once dammed and developed for human benefits are now being restored with the sole intention of environmental restoration (Doyle, 2000). The practice of dam removal has become a central feature of this transformation, increasingly recognized as the most realistic means for lasting river restoration (Gregory 2002). However, the emergence of Dam Removal in the United States is generating tremendous controversy against a backdrop of power crises, extreme cycles of flood and drought, endangered ecosystems, and changing social values (Pejchar 2001). In order to better understand this debate over dam removal and as a basis for further study in this thesis, it is necessary to review the historical, institutional and social development of the issue in river management.

3.1 Background of Dams in the United States

Rivers play a fundamental role in the history of the United States, having fueled much of the social and economic development in the country (Heinz Center 2002). Taming wild American rivers became symbolic of the rapidly advancing nation. With the expansion of agriculture, manufacturing and urban centers, rivers were quickly dammed to accommodate the profound development needs (Grossman 2002). A look into this growth of dams in the United States provides incredible insight into the cultural, economic, and social development of the country.

Early in the 20th century, the construction of dams in the United States was strongly supported by both the general public and the federal government, because of their value for hydropower, flood control, and water supply (Heinz Center 2002). Dams of this period were built in what was termed the *conservation* movement, aiming to manage or conserve natural resources, but solely for economic reasons. Conservationists recognized that most of the natural resources in the United States were federally owned as public lands, and planned to maximize the federal government's long-term economic benefits by developing these resources (Reisner 1986). Conservation issues were put high on the national agenda, and the federal construction of dams was heavily promoted for irrigation and hydropower.

This extensive development of rivers was not without its detractors, and a substantial *preservation* movement arose with a very different view of conservation. Preservationists attempted to minimize the commercial use of rivers, rather, calling for the preservation of their beauty and ecology. These early environmentalists protested many of the federal government's largest dams projects, however these efforts paled in comparison with the dominant conservationist agenda (Reisner 1986).

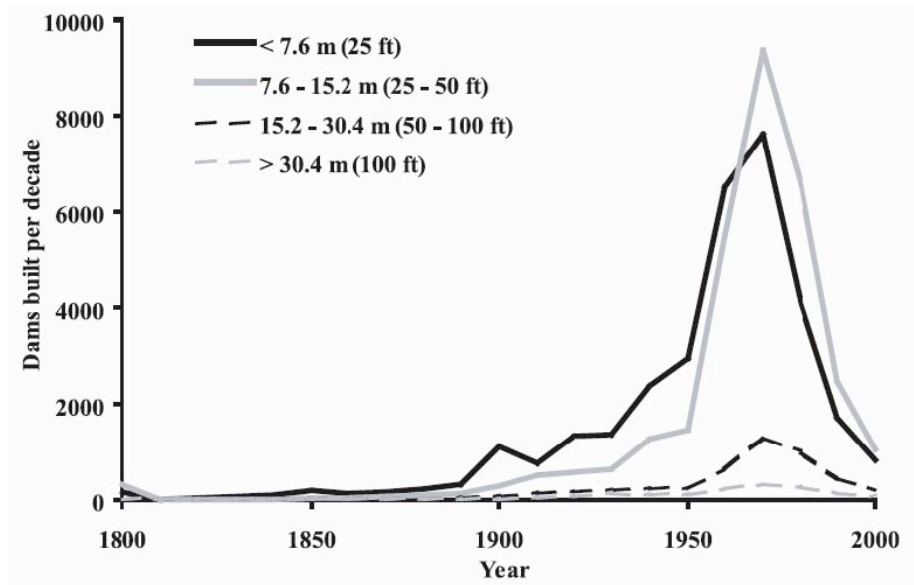
In the Great Depression era, principals of resource conservation continued to be broadly endorsed through extensive federal development and employment plans, becoming the catalyst for massive dam construction projects. These dams were seen as producing a broad range of social and economic benefits from a single infrastructure investment. Development of dams became the central water resources management strategy in the United States as thousands of dams were constructed during the peak of dam building between the 1930's and 1960's (See figure 2) (Reisner 1986).

As the American West rapidly expanded, urban centers and industrial agriculture grew to depend heavily on water and hydropower from these dams (Reisner 1986). In this era of development, dams helped to remedy serious problems of poverty, unemployment, drought, and floods, and were touted as the champions of the revival of post-depression America (McCully 1996). The engineering of enormous dams across nearly every major river in the United States has been one of the profound influences on the social and ecological landscape. By the end of the 20th century, there were more than 80,000 dams large dams, and as many as 2.5 million smaller dams spread throughout the country (Heinz Center 2002).

3.2 River Management Entities

The elaborate system of dams constructed on nearly every major river in the United States were all conceived and managed separately with no comprehensive water resource policy ever truly emerging (McCully 1996). The main actors in constructing this system were the *U.S. Army Corps of Engineers (ACOE)* and the *U.S. Bureau of Reclamation (BOR)*. Motivated by strong national interests and government pressure, these two organizations proceeded to build the largest, most influential dams in the country throughout the 20th century (Grossman

2002). While the ACOE and the BOR dominated the building of large nationally significant dams, their authority waned as their era of large federal dam projects came to an end mid century (Reisner 1986). Since the end of the federal dam building era, thousands of private dams have been built, which now represent a large majority of the dams in the country. Most of these are hydropower dams licensed and regulated by the *Federal Energy Regulatory Commission (FERC)*, now the main governmental actor in regulating the nation's dams. Beyond the traditional technical knowledge of the ACOE and the BOR, and FERC's regulatory authority over private hydropower dams, there exists no single federal agency responsible for the nation's dams (Grant 2001).



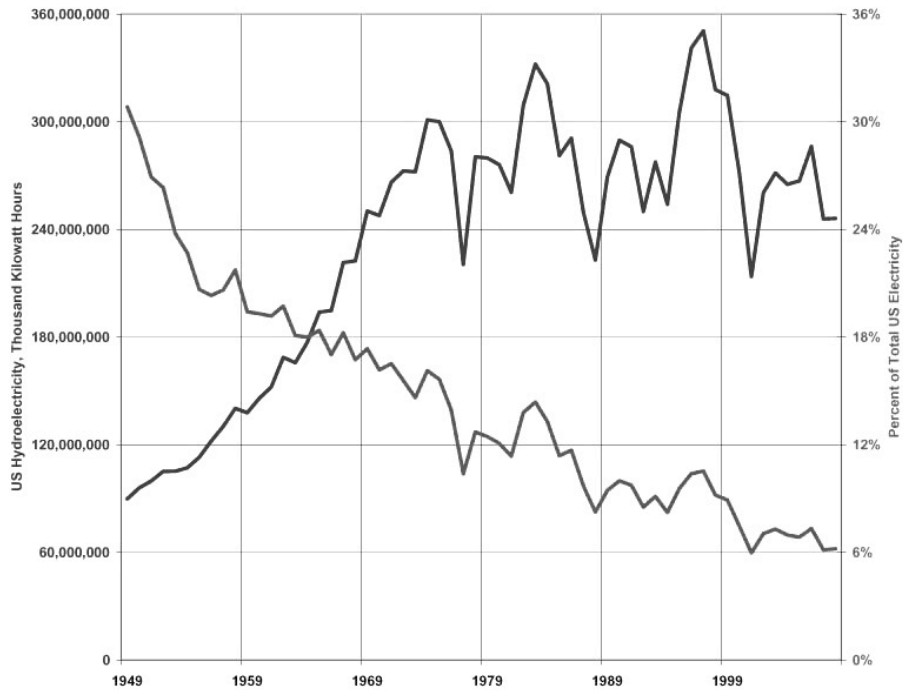
source: ASCE - National Inventory of Dams (2001)

Figure 2. Number and size of dams built per decade over the past 200 years in the United States

3.2.1 The Federal Energy Regulatory Commission (FERC)

FERC is a separate and independent federal commission whose members are appointed by the President, normally for consecutive five-year terms (Carney 2000). FERC's general function is to ensure that licensed private hydropower dams do not interfere with the public's interest. Traditionally, FERC heavily promoted the increased utilization of hydropower in the United States. Hydropower accounted for a major part of the nation's energy capacity, averaging well over 50% historically and nearly 25% until 1970 (see figure 3) (Sternberg 2008). With this extensive array of hydropower dams, FERC's licensing and regulation duties are a key factor in river management.

FERC policy has increasingly become politically contentious as many of its hydropower dam licenses are now expiring causing issues around hydropower to be re-examined. The average planned service life expectancy of a dam is 50 years based on hydrologic, seismic, and structural concerns of the component concrete and foundation materials (Carney 2000). Most licenses issued by FERC are for 30 or 50-year periods, and are only occasionally reviewed for basic safety, economic and environmental inspections. With most dams constructed before the 1960s, many have aged beyond their planned life expectancy and are operating on expired licenses with temporary annual renewals. The American Society of Civil Engineers estimates that presently more than 25% of the 2.5 million dams in the United States are at the end of their 50-year design life; and the figure is set to reach 85% by 2020 (ASCE 2004).



source: U.S. Energy Information Administration (2010)

Figure 3. Annual hydropower production as a percentage of total electricity in the United States

As these hydropower dam licenses expire, FERC has been left to reevaluate its relicensing policies with little oversight or guidance. Historically, FERC implicitly assumed that continued operation of hydropower dams was in the public interest (Kosnik 2006). Traditional FERC policy would have provided automatic license renewal for most hydropower dams, however, new federal environmental mandates have forced FERC to take into account basic ecological and social concerns, such as fish and wildlife protection and Native American rights. This has to be done in consultation with the National Marine Fisheries Service (NMFS), the United States Fish and Wildlife Service (USFWS) and Natives American tribal governments (Kosnik 2006).

Under these new guidelines, any dam project up for relicensing must meet modern environmental, social, and economic standards. This policy shift forced dam removal into FERC's agenda and in 1994 the agency finally developed a dam removal clause in its policy (Pejchar 2001). Suddenly finding itself in one of the most prominent and controversial positions in river management, FERC is now the central agency presiding over most dam removal proposals.

FERC's authority to order dam removal has caused an upheaval in the hydropower industry. Many new issues emerged regarding the responsibility for demolition costs, the compensation to dam owners for the value of the dam, and the liability for ecological effects of removal (Kosnik 2006). All of these questions are still largely unresolved in FERC policy and are typically dealt with on a case-by-case basis with costly, time-consuming litigation. As thousands more dams come up for relicensing, FERC will undeniably play a central role in the removal of many dams. FERC policy will continue to be a key aspect in river management and any policy analysis must be viewed through this institution.

3.2.2 River Protection and Preservation Entities

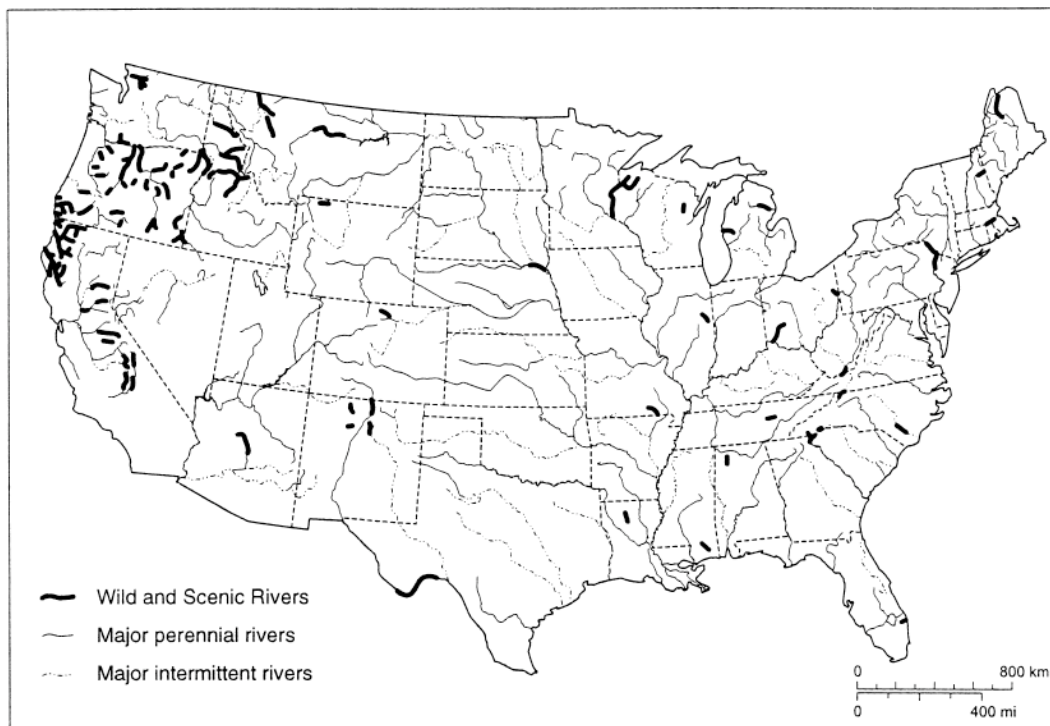
During the rapid construction of dams in the United States, little thought was given to the potential long-term environmental impacts, such as on fish migration, water temperature, sediment transport, coastal erosion, and general fragmentation of river ecosystems (Bednarek 2001). In recognition of these effects, various organizations have been created, and various legislations have been utilized to enact protection and funding measures for rivers.

While the major river management entities responsible for the engineering and development of the nation's rivers have traditionally been dominant, the appeal for river preservation and protection has also been present. The early calls for river preservation are the seeds of the contemporary movement for river restoration.

The regulation and protection aspects of river management take place in a wide array of governmental entities, such as the *U.S. Fish and Wildlife Service (FWS)*, the *National Oceanic and Atmospheric Administration (NOAA)*, the *National Marine Fisheries Service (NMFS)*, the *U.S. Department of Commerce*, the *U.S. Department of the Interior*, and numerous others (Graf 2001). However, organization of the movement for river preservation and restoration has relied heavily on the work of NGO's, such as *Friends of the River*, *American Rivers*, *International Rivers*, and the *Hydropower Reform Coalition*.

Both these governmental entities, and non-governmental organizations use a range of legislations that were drafted during the 1960's and 70's when a number of environmental laws were passed. In 1969, the *National Environmental Protection Act (NEPA)* became one of the most important environmental legislations, setting up a comprehensive national policy for environmental protection and environmental impact statements. This legislation preceded the formation of the *Environmental Protection Agency* in 1970 and the *Endangered Species Act* in 1973, both of which have prominent roles in river management policy. A particularly important yet underutilized legislation is the *National Wild and Scenic River Act* of 1968 (see figure 4), which designates and preserves select rivers with remarkable ecological and cultural values. However, only .03% of the national's rivers are protected under this act.

These environmental laws often dictate the planning and actions that agencies take to manage rivers. They hold a central role in the policy changes taking place around river management. However many laws still require complex interpretation and unusual applications in order to protect river systems. While the work of NGO's has been substantial and many governmental entities exist to manage rivers, there is significant fragmentation, inefficiency and lack of policy around the protection and restoration aspects of river management.



source: American Rivers (2010)

figure 4. Rivers in the United States protected under the *National Wild and Scenic River Act*

3.3 Social Perspective on Dams

As dam infrastructures have aged, deteriorated, and lost their intended purpose, the consequences of the dam building era has come to reality. These dams provided valuable services and extensive economic benefits; however, this has been offset by the extensive environmental effects (Heinz Center 2002). With the inevitable aging of the country's dams, the decisions to renovate, repair or remove dams are becoming increasingly common. Dams have become much less critical to United States infrastructure, the financial costs of maintaining them have become greater, and society's understanding and appreciation of the values of healthy rivers has grown (Sternberg 2008). The general social perspective of dams has shifted from the 20th century view of dams as important commodity sources to now considering dams as serious liabilities (Sternberg 2008). The unforeseen environmental consequences of dams have brought up critical question of whether the predicted social and economic benefits of dams have actually been achieved and whether the tradeoffs of societal priorities are worth the ecological damages (Christian et al. 2010).

This new socio-political perception of dams has been bolstered by numerous factors from a variety of standpoints on ecology, hydrology, economics, politics, energy production, human rights, and safety (see Fieldman, 1991, Wilkinson 1992, McCully 1996; Born 1998, Pejchar 2001, Grossman 2002, Bowden 2003). Cumulatively, these authors have led to a broad discourse over the sheer rationality of dams. The traditional logic behind dams has been drastically reevaluated in an understanding that the economic benefits of dams may have failed to justify their long-term ecological costs (McCully 1996). This reasoning has become the fundamental basis in the call for dam removal and represents the large shift in river management discourse.

Given the long life of these dam structures, the political and societal values around them were bound to change. Traditional regimes are being confronted, exemplified by many of the famous large dams in the United States developed to break society out of the Great Depression, which are now the subjects of a significant movements for dam removal and river restoration. This widespread scrutiny over the perceived permanence of dams and the advancement of dam removal further into mainstream society points to a fundamental change in discourse taking place. As has happened to numerous other environmental causes before, dam removal, once a radical fringe idea, is now becoming a mainstream accepted issue.

3.4 Ecology of Dam Removal

Before the 1970's, few understood the ecological impacts of dams on rivers (Graf 1999). Early ecological studies such as Beaumont (1978) and Stanford (1979), introduced a stronger literature base helping river restoration grow into a unique field of research. River restoration progressively changed from a focus on simpler ecological issues such as water quality and flow quantity to broader community interactions in the watershed (Born 1998). Building on these holistic concepts of river systems, notable studies greatly increased understanding of the negative impacts of dams (see Vannote 1980; Bravard 1986; Amoros, 1987). These studies revealed that dams can be extremely damaging to river ecosystems through altering the natural cycle of flow, transforming the biological and physical characteristics of river channels and floodplains, and fragmenting the continuity of rivers. Furthermore, they showed that many river restoration projects ultimately had only minor success due to the high prevalence of large dams on most rivers (Graf 1999).

Restoration began to be aimed specifically at dams, such as structural modifications, development of fish ladders and water releases to simulate seasonal flows. These attempts also failed to show lasting ecological improvement as the dams proved to have an insurmountable effect on the watershed (Graf 1999). Evidence mounted that the widespread damming of rivers even hindered broad scale ecological restoration, as fewer than 50 rivers in the entire United States had more than 100 km of free-flowing river channel (American Rivers 2010).

Due of the findings of these river restoration studies, the scrutiny of dams initially came from the natural and biological sciences. However, many social, economic and regulatory studies concerning dams became significant in a more complete academic critique of dams (Poff 1997). Beginning In the 1990's, after 100 years of intense construction of dams, and 20 years of restoration efforts, the mounting scientific evidence of the environmental impacts of dams helped introduce dam removal as a serious river restoration concept.

While preliminary anecdotal data offers strong support for dam removal as an environmental restoration tool, sufficient academic examination specifically on the dam removal concept has not yet materialized (Doyle 2008). In general, the practice of dam removal has outpaced the building of an academic scientific foundation (Bernhardt 2005).

As a mechanism for sharing information and experiences about the growing practice, researchers have set out to create and coordinate databases on dam removal projects. Studies by Pohl (2002) and Poff (2002) coordinated and verified dam removal listings from a variety of fragmented databases, including The National Park Service, National Program for Dam Performance at Stanford University, and the NGO American Rivers' dam removal list. This research has expanded inventories to include trends in the dam removal rationale as well as categorizing the tremendous variation in river and dam attributes.

A more recent endeavor by Bernhardt (2005) broadened to create an inventory of all river restoration activities in the United States. This was prompted by the lack of documentation of river restoration outcomes and by the fragmented understanding of the cumulative effects and costs of current restoration activities in the country. This led to the collection and cataloging of over 40,000 river restoration projects and the creation of the *National River Restoration Science Synthesis (NRRSS) Database*. This database found that the number of river restoration projects increased exponentially since 2000, and the magnitude of costs of restoration projects had reached over \$15 billion since 1990 (Bernhardt 2005). Research such as this has confronted the scarcity of empirical data around dam removal, which is important for supporting this emerging science.

As evidence of the increasing interest in the science of dam removal, many major American geographical and ecological societies (AGU, GSA, AAG, NABS, ESA) have recently hosted special sessions on dam removal, while two national panels (Aspen Institute and Heinz Center) are examining and producing reports specifically on dam removal (Doyle 2008). Until recently, the lack of scientific, peer-reviewed academic backing has hindered interactions between scientists, policymakers and community members faced with dam removal decisions (Clark 2007). As policy is drafted to integrate dam removal into river management, the continued growth of academic scientific literature will be vital.

4.0 Causes for the Emergence of Dam Removal

While river restoration covers a broad range of actions to improve ecological features of rivers, dam removal has become the most visible due to its potential for large-scale restoration (Grant 2001). As discussed above, the improved scientific understanding of the negative environmental impacts of dams has provided the main rationale for the emergence of dam removal (Bednarek 2001). However, safety worries, cultural issues and energy economics have also played significant roles. This chapter will focus specifically on the ecological and economic causes for the emergence of dam removal.

4.1 Environmental Causes for Dam Removal

In the history of river development it was widely believed that the adverse environmental impacts of damming rivers were minimal and instead, the social and economic benefits of dams were celebrated as examples of ingenuity and progress (Nilsson 1994). In the early era of dam building, the benefits such as hydropower, irrigation and flood control were tangible and easy to quantify. Ecological effects, if acknowledged at all, were approached again through engineering (Vorosmarty 1997). Unforeseen environmental changes associated with dams are increasingly apparent and the mounting ecological costs have now become the basis of the call for dam removal.

Studies have revealed that the ecological damages associated with the building of a single dam can extend the entire length of a river and beyond, affecting the surrounding forests and watershed and damaging nearby estuaries, beaches, oceans and biodiversity on a regional scale (Stanford 1995, Poff 1997). Dams have been attributed to extreme loss of aquatic and riparian habitat, and significant reductions in native species (Losos 1995).

Dams have been a main factor in the decline or complete extinction of anadromous fish stocks, especially fragile salmon populations (Pejchar 2001). Due to this, one of the most immediate factors driving dam removal is the federal *Endangered Species Act* calling to revive fish populations that have been blocked by dams from historical spawning grounds (Pejchar 2001). Salmon runs on the East Coast are at 1% of their historic levels, partly due to the fact that East Coast Rivers are blocked by over 900 dams (Hart et al., 2002). In the Western states, a large majority of the 30 species of salmon and steelhead populations have significantly declined and been listed as endangered (Poff et al., 1997, Bednarek, 2001). After the long timeframe necessary to detect and understand these consequences, the ecological impacts of dams are now considered indisputable. The scientific community has begun to shift attention to the new science that must be undertaken regarding the restoration of rivers, partly through the dam removal (Goodwin 2006).

While it has been assumed that dam removal will simply and immediately reverse the ecological effects of dams, the science behind dam removal requires a complex understanding of how a watershed will respond. Although dam removal studies are limited and only a small number of peer-reviewed ecological studies on completed dam removals are available, scientists are beginning to build evidence of the ecological benefits of dam removals. A growing body of research has begun documenting these ecological benefits (Bednarek 2001; Gregory 2002, Doyle, Harbor, and Stanley 2003). These studies have shown that dam removal in combination with additional watershed restoration work can significantly reduce and eventually reverse the harmful effects that dams have caused to rivers.

River ecosystems tend to be quite resilient and have responded very rapidly and positively following dam removals. Many dam removals have ultimately assisted in returning not only the river, but also surrounding terrestrial ecosystems to natural conditions. Restoration of an unregulated flows has resulted in increased biotic diversity through restoring natural flood regimes, spawning grounds and habitat, sediment transport, and connectivity of a river, some of the most important factors for healthy river ecosystems (Poff 1997). In dam removal projects throughout the Pacific Northwest, native fish that have been blocked for decades have returned to rivers and expanded their numbers within only two years of the dam's removal (Pejchar 2001). Although studies are limited, the evidence so far is encouraging of the cumulative river restoration benefits of dam removal. This proof has emboldened the environmental calls for dam removal, however, continued examination of ecological outcomes and quantifying the resistance and resilience of river ecosystems is essential to furthering the concept of dam removal.

4.2 Economic Causes for Dam Removal

Simply put, dams have a finite life expectancy (Sternberg 2008). Aging dams have escalating repair and maintenance costs, while also becoming less able to provide benefits such as hydropower, water supply and flood control. Costs to repair or rebuild a deteriorating dam typically run into millions of dollars (Born et al. 1998). This high cost has made maintaining obsolete dams unprofitable and untenable. Another primary concern is the safety of aging dams. Some 9,000 dams in the United States have been classified by the Army Corps of Engineers as posing significant safety hazards and high risk of failure (Heinz Center 2002)

As dam structures diminish in economic value to the owners, and as safety hazards worsen, dam removal becomes an increasingly realistic option. This simple economic reasoning behind dam removal has ironically forced dam owners themselves to accept and support the practice, making many dam removals not ecological restoration decisions, but straightforward matters of economics.

Further economic considerations come from communities who will directly benefit financially from dam removal and view the removal process as a local investment. For example, the Pacific Coast Federation of Fishermen's Associations (PCFFA) has formed a coalition of commercial fisherman to lobby for the removal of many dams in the western United States, as more than 75% of the nation's \$152 billion/year fishing industry depends on the environmental health of rivers (American Rivers 2010). These commercial fishermen, traditionally conservative on environmental issues, have been strong advocates of dam removal because their economic livelihoods are at stake. Other significant examples of economic rationale for dam removal exist in native tribal communities, agricultural communities, as well as for recreation and tourism.

Another key economic component influencing the emergence of dam removal is reflected in the changing economic lay out of renewable energies and hydropower. While power generation is a complex, political business, it is generally accepted that energy production of many aging hydropower dams has recently become significantly less economically viable (Crain 2008).

About 3,000 hydropower dams generate roughly ten percent of the nation's electricity and while most of those dams will continue to operate profitably, many dams no longer produce enough power to justify their benefits, especially in comparison with renewable alternatives such as solar, wind, and geothermal energy sources (Workman 2007). These renewable energies are becoming well established and widely accessible as they are often far more ecologically sound and require significantly cheaper infrastructure investments (Lavigne 2005).

Additionally, many early hydropower dams in the United States have been made redundant and unnecessary following the establishment of wide spread regional energy grids and efficiency measures (Workman 2007). Conservation and efficiency improvements are solutions found in existing energy technologies, which could significantly reduce energy consumption in the United States, and ultimately reduce the reliance on obsolete hydropower dams (Workman 2007). Given hydropower's small percentage in the energy layout of many communities, minor efficiency adjustments could potentially allow for the removal of many obsolete small-scale hydropower facilities in the country (American Rivers 2008). While dam removal may seem expensive in the short term, the elimination of maintenance costs, safety repairs, and ecological upgrades proves to be much less costly (American River 2010).

Modern renewable technologies, energy efficiency measures, and effects on commercial fisheries, are showing that the economic justification for many aging hydropower dams no longer holds. Although there is significant argument about the best renewable energy, traditional hydropower dams are discussed much less in modern energy debates. The resources spent on maintenance and repair of ageing dams could be spent on dam removal and the expansion of these alternative renewable energies (Lavigne 2005).

5.0 Introduction to the Elwha River Dam Removal Case

The discussion in previous chapters has explored the history of dams and river management in the United States, as well as the transformation taking place through the emergence of the dam removal concept. All of these elements are evident in the history of the Elwha River and in the evolution of the Dam Removal project. The Elwha case reflects the larger process of transformation in river management, but also provides specific policy lessons, which are discussed later in this thesis. Before applying a theoretical analysis of policy change to the Elwha River Dam Removal case, this section will describe the physical setting and the relevant institutions and actors.

5.1 Background of the Elwha River

Throughout the Pacific Northwest United States, most rivers no longer run free but are blocked by thousands of dams, mostly constructed during the boom of the early 20th century. While these dams have served human interests well, they have also had substantial ecological effects. Central among these effects is the drastic decline of salmon populations, the signature species of the Pacific Northwest and an indicator species for the health of region's ecosystems (Bender, 1997). Impassable dam barriers obstructing crucial migration and spawning cycles are a main factor in the decline of salmon. The loss of wild salmon has had severe cultural and economic ramifications for the Pacific Northwest, and dam removal has emerged as one of the leading solution to restore the rivers and salmon in the region. Numerous dam removal projects are in progress and the Pacific Northwest region has now become the epicenter of the river restoration movement in the country. The most well known of these projects is on the Elwha River, where the removal of two large hydropower dams is now the largest dam removal, and one of the most expensive restoration projects, ever performed in the United States.

The Elwha River is located on the Olympic Peninsula in Northwest Washington. The main stem of the river is 80 km long, and drains over 175 km of tributaries and 525 square km of the pristine Olympic mountain range (see figure 5) (Bender 1997). Nearly the entire watershed lies protected within the Olympic National Park. Historically, the Elwha River was renowned for its fish runs, once home to an estimated 400,000 salmon and trout, including all six species of Pacific Salmon (Crain 2008). These fish were a central part of the surrounding ecosystems, contributing to the sustenance of more than twenty species of wildlife and countless plants in the area (Gowana 2006). Furthermore, the salmon runs provided the cultural foundation of the Native Elwha Klallam tribe as well as the economic livelihood of a vibrant river and ocean commercial fishery.

In 1910, the Olympic Power Company constructed the 150 m long, 50 m high Elwha Dam only 7 km from the mouth of the river. In 1927, the 70 m high Glines Canyon dam was constructed 20 km further up river, in a deep canyon of the Elwha River gorge (see figure 6). These two hydropower dams were constructed long before the creation of Olympic National Park, and provided vital electricity directly to the local lumber mill in Port Angeles. Through supporting the mill and the booming logging industry in the region, the dams had a significant part in the early economic development of the Olympic peninsula. Yet, these dams also caused significant ecological and cultural impacts on the Elwha River.

Figure 5. Map of the Olympic Peninsula



source: U.S. Geological Survey (2006)



Figure 6. Diagram of the two Elwha River Dams

Since creation of Olympic National Park in 1938, the entire Elwha River watershed has been protected from logging, development, and degradation, leaving the Elwha and Glines Canyon Dams as the main disruption to the ecology of this river. While the Olympic National Park is protected, logging and milling are still the main industry in the region, making the ecology of the Elwha River even more important.

This pristine wilderness of the Olympic National Park led to its designation as an *International Biosphere Reserve* and *World Heritage Site* in 1976 (UNESCO 2012). However, this same year, the *Federal Energy Regulatory Commission's* hydropower dam licenses on the both the Elwha Dam and Glines Canyon Dam expired, bringing the future of the dams into question. When the Crown Zellerbach Energy Corporation, which owned the dams, applied for FERC license renewal, controversy erupted with strong sentiments for and against the dams suddenly rampant throughout the region.

The ecological effects of the two Elwha River dams were well recognized, yet many stakeholders considered the hydropower they provided essential. This division became a defining issue in regional politics of the Pacific Northwest. Fierce debate spawned a variety of proposals, one of which was dam removal. The call for dam removal, generally an unheard of concept at the time, quickly grew into a political storm. As the dams laid within the Olympic National Park, the dam removal debate created a contentious political dynamic between the *National Park Service* and the *Federal Energy Regulatory Commission* (Crain 2008). The dam removal setting amongst these two federal agencies would come to expose the larger issue of policy fragmentation in United States river management.

The dam removal proposal on the Elwha River gradually developed into a legitimate policy debate, putting the traditional discourse around river management under a microscope, and giving the concept of dam removal its first political footing. The Elwha River dam removal is now one of the world's largest river restoration projects, and a remarkable example of fundamental policy change. While the setting of the Elwha River is unique, the discussion is relevant to broader river management in the United States. Before further analyzing policy issues in Elwha case, it is necessary to first establish the policy change phenomenon and the main political venues where policy change occurs.



source: John Gussman (2011)

Figure 7. Salmon in the Elwha River blocked below the Elwha Dam

6.0 Policy Change Theory in River Management

The background presented in previous chapters has set the stage for the policy challenges inherent to the transformation of river management. Studies around the ecological and socio-economic aspects of river management have been thorough, however, policy struggles continue to be substantial, leading this thesis to select the theory of policy change as key component of the research. Utilizing policy change theory from a synthesis of authors, this chapter first discusses policy change as a phenomenon and the particular perspectives chosen for this research, then applies policy change analysis to river management in the United States.

6.1 The Policy Change Phenomenon

While the changes taking place in river management policy are unique, they can also be viewed as an example of the policy change phenomenon, which has occurred in numerous other issues. The policy change phenomenon is generally defined as the replacement of existing policies via modification, reversal, termination, or adoption of new policies (Lowry 2003). However, these policy changes can occur through various paths, as is evident in the vast number of notable authors and theories on the subject.

Early research by Hecl (1974) described *conflict expansion* and *policy learning* as causes for policy change. Sabatier (1988) proposed *systemic perturbations* as a central part of policy change. Baumgartner and Jones (1993) characterized policy change as involving long periods of *incremental changes* punctuated by *large leaps* of major change. Rochefort (1994) described institutional shifts in *policy venues* as a central factor of policy change. Kingdon (1995) focused on the pre-decision process, such as how *agenda setting* and *policy windows* affects policy change outcomes. Sabatier and Jenkins-Smith (1999) defined policy change as a function of competition within and between advocacy *coalitions*.

Each of these perspectives offers insights and basic parameters for inquiry into the realms of policy change; however, this research is based in three main policy change theories, which are fitting to river management (see figure 8). Analysis in this thesis focuses on the theory of *advocacy coalitions* from Sabatier and Jenkins-Smith (1999), represented by the constituencies in river management that generally advocate or oppose dam removal restoration projects. The analysis also sees the theory of *policy windows* from Kingdon (1995), as represented by the opening of social-environmental discourse concerning rivers, the current rapid increase in FERC dam license expirations, and the policy vacuum in the lack of proper entities in river management.

	Theory (Key Authors)	Discipline	How Change Happens	This theory may be useful when:
Global Theories	1. "Large Leaps" or Punctuated Equilibrium Theory (Baumgartner, Jones)	Political Science	Like seismic evolutionary shifts, significant changes in policy and institutions can occur when the right conditions are in place.	<ul style="list-style-type: none"> • Large-scale policy change is the primary goal • Strong capacity for media advocacy exists
	2. "Coalition" Theory or Advocacy Coalition Framework (Sabatier, Jenkins-Smith)	Political Science	Policy change happens through coordinated activity among a range of individuals with the same core policy beliefs.	<ul style="list-style-type: none"> • A sympathetic administration is in office • A strong group of allies with a common goal is in place or can be formed
	3. "Policy Windows" or Agenda Setting (Kingdon)	Political Science	Policy can be changed during a window of opportunity when advocates successfully connect two or more components of the policy process: the way a problem is defined, the policy solution to the problem or the political climate surrounding their issue.	<ul style="list-style-type: none"> • Multiple policy streams can be addressed simultaneously (problem definition, policy solutions and/or political climate) • Internal capacity exists to create, identify, and act on policy windows

source: Organizational Research Services (2010)

Figure 8. Summary table of three key policy change theories and respective authors.

The above theories are guiding perspectives for this thesis, and also inform the policy change theory of Lowry (2003). Theory from Lowry (2003) is of particular interest to this thesis because of its creative synthesis of traditional policy change theories, and its function for modern environmental issues, such as river management. Key concepts for analyzing proposed policy changes are derived from Lowry (2003) regarding *Political Receptivity* and *Physical Complexity*. Different degrees of these variables can greatly affect policy change outcomes and are valuable for analyzing and categorizing the change of individual cases within the broader river management transformation. These factors help the analysis of the Elwha River Dam Removal case study in the next chapter.

6.2 Political Receptivity and Physical Complexity

To define the political circumstances that determine outcomes of policy change proposals, two conceptual categories are useful: *Political Receptivity* and *Physical Complexity*. Essentially, these two dimensions characterize how decisions are made (political receptivity), and how difficult putting the decision into effect will be (physical complexity).

The factor of Political Receptivity can be traced to the policy change theory of *Advocacy Coalition Framework (ACF)* from Sabatier and Jenkins-Smith (1999). The ACF focuses on the interactions of different coalitions of actors with shared policy beliefs. It argues that policy change is a function of competition between coalitions that are attempting to translate their beliefs into policy (see figure 9). In river management situations, the ACF can be useful to examine the interaction between river advocacy coalitions and other competing actors and to assess the degrees of political receptivity to the proposed river policy changes. As these coalitions attempt to affect specific policies in their favor, their interactions range from collaborative to conflictual, greatly influenced by whether the costs of status-quo are high and readily apparent, and whether scientific information on potential benefits of change are widely embraced (Sabatier and Jenkins 1999). Within a given policy debate, there are generally two main coalitions operating in the primary decision-making venue. Whether this political venue is tolerant of change and receptive of new proposals is another key factor.

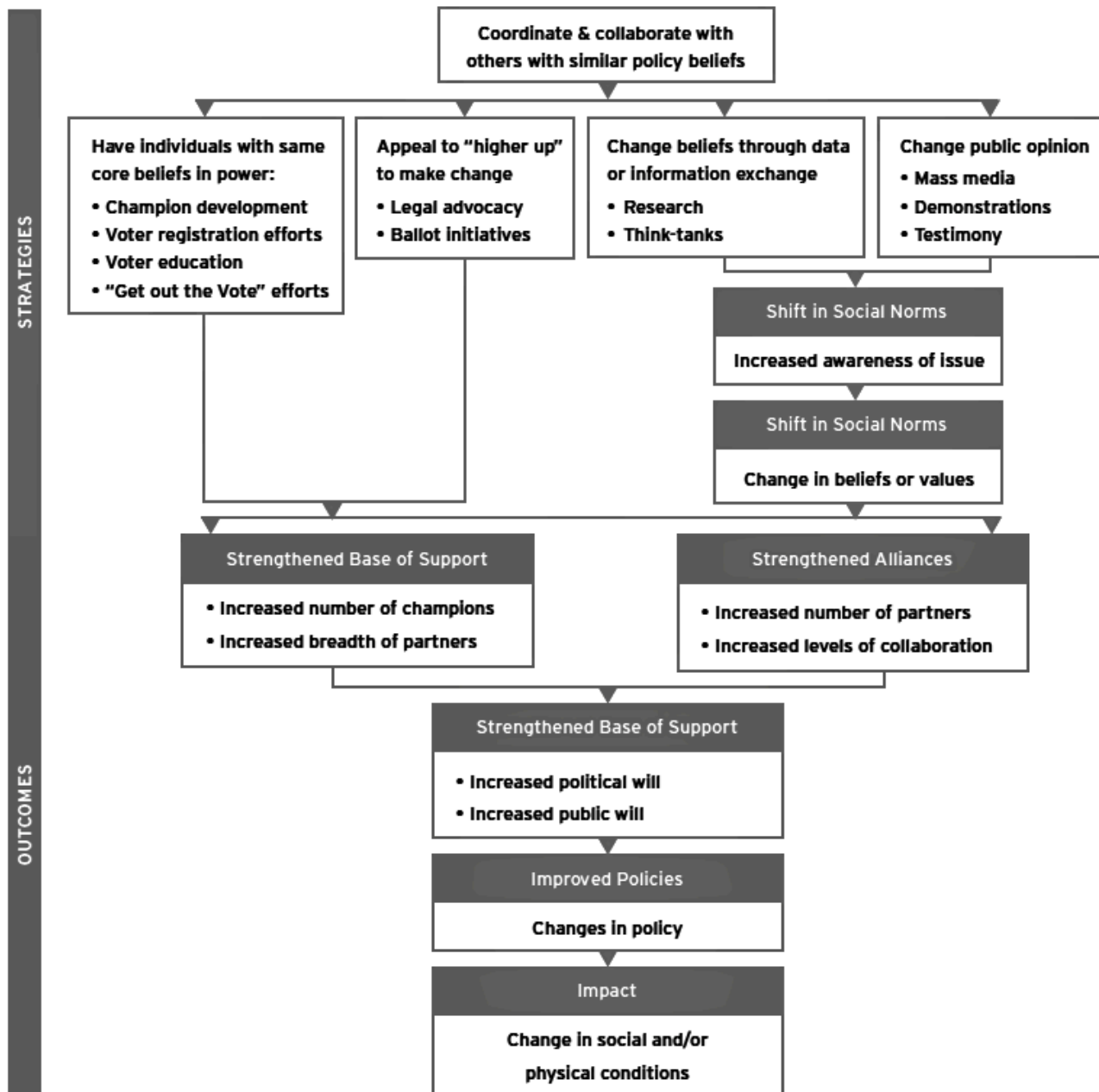
To define Physical Complexity, it is helpful to use the theory on *Common Pool Resources* from Ostrom (1990), which focuses on describing cooperative efforts among resource users to protect and sustain a resource, such as a river. The theory on CPR is useful in river management policy to examine the various characteristics of the river and to assess the physical complexity of the proposed river policy changes. Complexity of a policy change refers to not only the physical scale and characteristics of the project, but also relates to the dimensionality of political jurisdictions involved and the number people affected by the change (Ostrom 1990). These various dimensions of physical complexity are crucial in river policy debates, as highly complex situations are often more challenging to change.

Together, the *Advocacy Coalition Framework* and the theory on *Common Pool Resources*, show the foundational principals behind *Political Receptivity* and *Physical Complexity*, crucial variables influencing policy change. The interaction of different low or high degrees of these independent variables produces significant variations in policy change outcomes. Lowry (2003) contributes by defining and categorizing these different variations of change into; Fundamental Changes, Experiential Changes, Secondary Changes, and Disjointed Changes. Fundamental policy changes are likely outcomes when decision making venues are largely receptive to change, projects involve few political jurisdictions, costs of the status-quo are high, and there exists broad scientific consensus on the benefits of change. Such conditions are said to produce dramatic and permanent policy changes, for example complete dam removal and extensive river restoration. Because this is the principal type of policy change analyzed in this thesis and in the following Elwha River case study, fundamental policy change is the primary focus.

This categorization of policy change from Lowry (2003) suggests that when coalitions are receptive to change and the proposed changes are low in complexity, fundamental policy change, such as dam removal, will occur. This is a highly plausible conclusion, however it is rather simplistic and vague. Policy change can almost always be expected in less complex and less controversial contexts. The converse to this conclusion is that a lack of political receptivity combined with high physical complexity prevents dam removal policy changes from occurring and therefore significantly reduces potential for the broad diffusion of dam removal policy change.

While these are rational conclusions, current projects concerning the removal of large, complex and contested dams challenge this notion. Recent cases of fundamental policy change have occurred where dam removal

decisions emerged in highly complex and unreceptive situations, such as in the Elwha River Dam Removal analyzed in the next chapter. The proliferation of these fundamental policy changes resulting in dam removals show that the institutions involved in river management are increasingly receptive to change and able to overcome complexity. These cases of fundamental policy change are of particular interest to this thesis, as they point to the growing momentum of the larger policy transformation in river management.



source: Organizational Research Services (2010)

Figure 9. Advocacy Coalition Framework adapted from Sabatier and Jenkins-Smith

6.3 Policy Change in River Management

Decision making on river issues is a difficult and contentious process. Traditional reductionist river policies were set in place long before the environmental consequences were understood (Ludwig 1993). The United States retains an ineffective and inefficient approach to river management consisting of a fragmented assortment of institutional actors. This arrangement is in stark contrast to the example being set by the European Union's adoption of the *Water Framework Directive*, which is coordinating river management through *Integrated River Basin Management Plans*, as a means of achieving the protection and sustainable use of river systems across Europe (Kallis et al. 2001).

While regulation and management is the realm of governmental entities, the stewardship of rivers in the United States is currently left up to the work of local initiatives and NGO's. These coalitions are forced to use a convoluted collection of legislations engage in endless court battle to create policy change. With little assistance or direction from government, river advocacy coalitions rely on innovative interpretations of the *Endangered Species Act* and the *Clean Water Act*, legislations meant as last resort environmental protection measures, not as mechanisms for well-organized environmental management. Although positive verdicts in cases using of these legislations signal increased political receptivity, their impact still depends on the approximated interpretations of the laws as nowhere does it require or guarantee river restoration measures.

Although there is skepticism concerning the lack of government responsiveness in the United States, it has been shown that long-standing policy traditions can shift dramatically, even when involving issues traditionally powerful networks of interest groups and politicians (Clark 2007). Environmental governance is example of an area in which government policies have changed over time (Lowry 2003). In the transformation of river management, specifically involving hydropower dams, traditional policies inherent to the dam building era are being reviewed and replaced by new policies leading towards dam removal and river restoration.

While many would like to see swift, precise policy shifts, policy change is rarely accomplished quickly or easily. Considerable variation in the speed and extent of change exists between policy change outcomes, and in the case of river policy, each change can cumulatively represent incremental steps within the larger transformation (Lowry 2003). However, river advocacy based on improved scientific understanding of the social, economic and environmental effects of dams, must still confront the coalitions looking to maintain the industrial, resource based status quo who continually reject challenges to traditional river policy. The lack of acceptance of policy change, in the face of scientific consensus reflects deep social and economic factors that are not easily overcome.

River advocacy coalitions are now renovating the often vague overall goals underlying dam removal proposals. Unclear purposes behind a proposed environmental policy change, such as dam removals, can seem unreasonable to those coalitions who abide by the simplicity of traditional policy (Angermeier 1994). Critical factors affecting river policy change; the rejection of science, the interest in status quo, and lack of clarity of purpose, have long delayed the adoption of sound river policy. However, recent shifts in the characteristics of important agencies in river management are signaling increased political receptivity, and making policy change toward dam removal more likely.

As the public places increasingly value on healthy river ecosystems, a broad constituency for river protection has emerged (American Rivers 2001). This growth of active participants in river management policy debate is reflected in the influenced political receptivity to river restoration. This public involvement and shifting political receptivity has manifested in the new strict environmental mandates on the *Federal Energy Relicensing Commission (FERC)*, which have significantly aided in dam removal project proposals, and resulted in increased fundamental policy changes in larger river management regimes.

6.3.1 FERC Policy Changes

Theories of policy change show that policy variations in the incremental changes suggest momentum for a broader policy shift (Sabatier 1993). In river management, the policies of the *Federal Energy Relicensing Commission (FERC)* constitute an area in which their emphasis has incrementally changed over time and eventually contributed to the larger policy transformation. Traditionally conservative, and unsympathetic towards ecological river issues concerning its dams, FERC has now become a participator in interagency collaborations and river policy discussions

around restoration and dam removal. The enhanced receptivity of this agency has served to heighten the wider governmental recognition of river issues and fostered a political environment where significant shifts in river management can potentially occur. While the FERC relicensing process has softened to incorporate ecological river issues, it is rarely fully tested to prompt dam removals. Even on obsolete, uneconomic hydropower dams with expired operating licenses, the FERC tendency is to first favor hydropower resource use over other important uses of rivers.

A notable dam removal in 1999 of the Edward's Dam on Maine's Kennebec River is now considered a large turning point in FERC policy. This was the first notable dam removal decision where FERC supported ecosystem restoration over hydropower profits by removing a large, functioning hydropower facility for the sole purpose of restoring a river ecosystem (Grossman 2002). Subject to considerable pressure in this case, FERC used this highly publicized and controversial project to finally quiet its protesters. However, long after, this project remained one of the only significant examples of dam removal through the FERC process. While FERC was signaling a shift from being fully sympathetic to the needs of the hydropower industry to being more sensitive to environmental concerns regarding rivers, the change was gradual and reluctant. In the years since the Edward's Dam Removal in Maine, FERC has begun to accept its new role as the main political venue for dam removal policy.

Lowry's (2003) policy change principles of political receptivity and physical complexity are apparent in the example of FERC. Once an agency responsible for promoting and building dams, FERC is now seen as the only political venue which is somewhat receptive to change and dam removal. In terms of complexity, many hydropower dams are presided over solely by FERC, which reduces dimensionality and the potential for contentious disputes between agencies. Due to these changing factors, dam removal proposals under the FERC jurisdiction have growing prospects for fundamental policy change outcomes.

As many dam licenses expire, the costly patterns of the traditional resource use suddenly becomes very apparent. The dams are often deteriorated, require substantial maintenance, environmental retrofitting, and due to decreased hydropower production, are generally economically unfeasible; not to mention their high ecological and economic costs to river systems. The recognition of these costs by both the dam owners and the dam removal advocates make cooperation and fundamental changes toward dam removal much more likely in these cases. When the costs of the status quo are high and widely perceived as unacceptable, coalitions that previously competed and obstructed each other's efforts, can collaboratively pursue policy changes of the status quo. In many dam removal cases involving FERC, agreement on the costs of the status quo is often the single most critical aspect as it can also increase the speed of policy change emergence.

These various conditions of policy change help explain individual dam removal cases, but they also describe the larger policy changes in FERC. The high cost of FERC maintaining its traditional stances measured against the consensus on benefits of changing its policies have greatly increased the political receptivity in this entity. This favorable setting shows that FERC policies represent the closest thing to a national strategy on dam removal and the most promising path towards a broad policy change in river management.

7.0 Policy Change and Dam Removal on the Elwha River

The previous description of the phenomenon of policy change and its application to river management has led to the next two chapters on the Elwha River Dam Removal project. This case study adds important illustration to the research and provides specific policy change lessons for future dam removal proposals. As the tools for policy change analysis have been introduced and the geographical and historical settings of the Elwha River have been discussed, this section will isolate the relevant actors and show the chronological policy change process in the Elwha River Dam Removal case.

7.1 Dam Removal Advocates and Opposition

The various advocacy coalitions on the Elwha River suffered from a lack of adequate policy venues to moderate the case, which allowed years of disagreement to develop into hostility. Environmental activists, fishery scientists, and the Klallam Tribe teamed with the National Park Service advocating dam removal while local loggers, mill workers and the power company sided with Federal Energy Regulatory Commission, opposing dam removal. Advocates argued that FERC had no jurisdiction over dams in a National Park, while opponents felt FERC and the Elwha hydropower dams were necessary for providing important energy to the lumber mill and logging industry (Adams 1999).

While the dam removal advocates tended to be regional environmental activists promoting extensive regional restoration projects, the dam removal opponents were more localized and motivated by vested economic and employment interests in the hydropower utility and the lumber mill. This local opposition vehemently fought the dam removal proposal, proving especially effective at stalling the process. The debate over the dams became extremely polarized and brought political division into many aspects of daily life in the communities. While the reasoning of advocates for dam removal was simply based on the restoration of the river and salmon, reasoning for the stance opposing dam removal was more obscure.

The obvious explanation for the local opposition to dam removal was the loss of hydropower to the lumber mill, however this was difficult to justify as the dams provided only 40% of the total power needs for the mill, and dam removal would not necessitate finding an alternative power source (Bureau of Reclamation 2007). The opposition to dam removal appeared to grow from a more entrenched resentment towards the involvement of the federal government. While the Olympic National Park was protected, logging was still the main industry in the region, and until the controversy over the Elwha Dams, these rural logging and milling communities remained relatively undisturbed. The sudden debate over dam removal brought not only FERC intervention, but also involved the National Park Service, National Marine Fisheries Service, Department of the Interior and Federal Tribal Associations (Bender 1997). This antipathy to the federal government became a key obstacle in the dam removal negotiations especially as the United States Congress took a central role in the process.

Traditionally, the Federal Energy Regulatory Commission heavily promoted the utilization of hydropower, and in the case of the Elwha River, implicitly assumed that continued operation of the two dams was in the public interest. For nearly two decades, FERC held firm on its stance against removal of the Elwha River dams, and refused negotiation with the National Park Service. However, efforts by various river advocacy groups brought the issue of the Elwha River Dams and FERC's licensing process all the way to the United States Congress.

7.2 Congressional Intervention and Dam Removal

Influenced by the devoted advocates in the Elwha River dispute, Congressmen from states in the Pacific Northwest took a particular interest in the Elwha case, and precipitated a gradual increase in Congressional receptivity to the idea of dam removal (Crain 2008). In 1992, these Congressmen drafted, and the President signed the *Elwha River Ecosystem and Fisheries Restoration Act*, containing a specific mandate for the Secretary of the Interior to prepare a decision on the Elwha River dam removal. The act also authorized a federal buyout of the two dams from the private hydropower company at a cost of \$29.5 million (Bender 1997). While the federal government was already deeply involved in the project through the numerous agencies mentioned previously, the intervention by Congress represented a dramatic and unprecedented action.

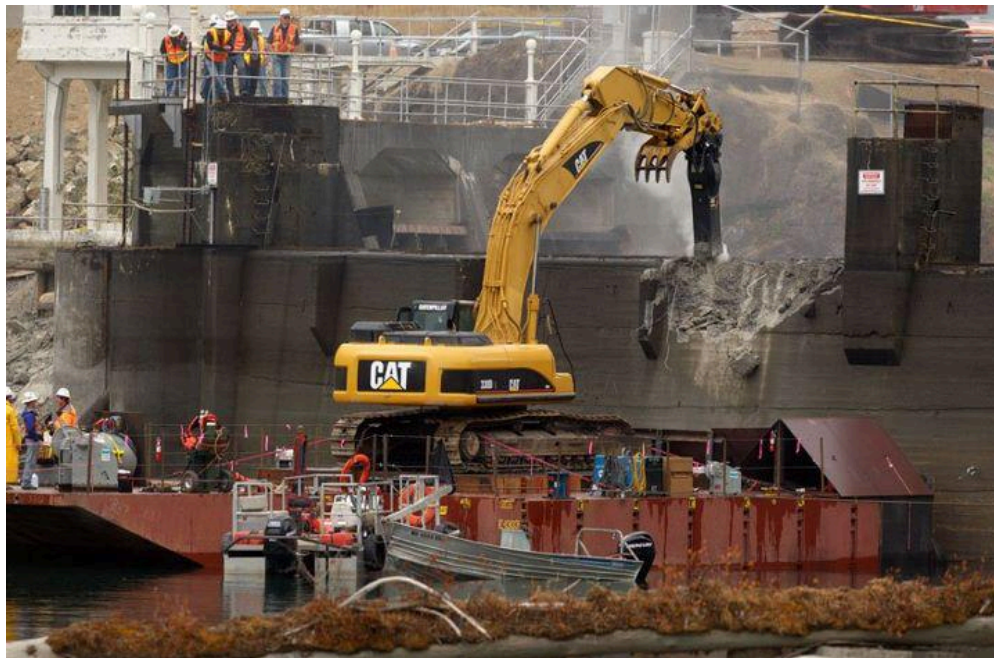
With the Congressional intervention and buyout of the dams, a tedious procession of Environmental Impact

Statements on the dam removal had to be prepared and funding for the project had to be appropriated. Even though dam removal had been decided as the proper course of action, the unprecedented size and cost of the Elwha Dam Removal caused the restoration project implementation to stall.

While local restoration efforts remained consistently focused, the change of political venue from a regional issue to a national Congressional issue proved to be a major delay in the dam removal negotiation process. The fate of the Elwha River was suddenly burdened by national politics, which had not yet fully accepted the concept of dam removal. Several conservative congressmen blocked funding for the project fearing that the Elwha Dam Removal project would create a 'domino effect' causing hydropower dams around the nation to be removed.

Frustrated at the stalemate in Congress, persistent efforts by local activists led to the formation of the *Elwha Citizens Advisory Committee* representing many of the main actors involved in the Dam Removal debate. This committee spent thousands of hours holding meetings, conducting interviews and mediating between stakeholders, eventually presenting a detailed report on the Elwha case to Congress in 1998. The cooperation and compromise presented in the report significantly calmed resentments in the local Elwha River region and allowed Congressmen to back off their politically motivated stance against dam removal. By the time of the release of the advisory committee's report, restoration projects were being carried out across the Pacific Northwest region, and many who were formerly opposed to dam removal began to recognize that the Elwha River project was not politically motivated, rather it was truly concerned with the restoration of the Elwha river and salmon.

In 2004, Congress appropriated \$135 million to the Elwha River Project, \$29.5 million for the buyout of the private dams and the remaining amount for the two dam removals and the various associated restoration activities in the basin. This funding made the Elwha River Dam removal the second most expensive restoration project in the United States, after only the Everglades Wetland restoration in Florida (American Rivers 2008). While many saw this as extremely costly, billions of dollars had already been spent on salmon restoration throughout the Pacific Northwest region and the Elwha project represented an unparalleled opportunity for extensive restoration. It required years more of logistical details and deconstruction contracts, before finally, in 2011, the first chunks of the Glines Canyon Dam and Elwha Dam were removed in a historic dam removal ceremony attended by tribal members, government representatives and local stakeholders. This began the multi-year process in the largest dam removal and river restoration project in United States history (see figures 10 and 11).



source: The Seattle Times (2011)

Figure 10. First day of Dam Removal on the Glines Canyon Dam



source: The Seattle Times (2012)



source: National Park Service (2010)

Figure 11. Removal in progress on the Elwha Dam and visualization of dam removal at the Glines Canyon Dam

8.0 Policy Analysis of the Elwha River Dam Removal

The previous chapter gave a sense of the contentious policy process leading to dam removal on the Elwha River. This was a pioneering journey in policy change, which tested the roles of various governmental entities, and exposed the larger institutional issues in United States river management. In order to better understand and appreciate the fundamental policy change in the Elwha case, the process can be broken down and analyzed through the previously discussed policy change theories. With an understanding of the function of advocacy coalitions, political receptivity and physical complexity in policy change; this chapter analyzes the main institutional actors that influenced the policy change process in the Elwha River case. This analysis leads to the conclusion of two key policy lessons regarding: the power and risk of *government settlements* for resolution of disputes over dams, and the importance of *alternative licensing procedures* for FERC hydropower dams. While the setting of the Elwha case is unique and unprecedented, these policy lessons are valuable for generalization to other dam removal cases in United States river management.

8.1 Political Receptivity and Physical Complexity in the Elwha River Case

While the Elwha dams had long been controversial, the catalyst that propelled the matter to the national stage was the issue of FERC hydropower dam licensing. Through many debates and court challenges, FERC adamantly defended its authority over the dams. This tendency to protect their own power, rather than a willingness to cooperate, was a common theme amongst the institutions involved. This created difficult policy fragmentation between FERC and other governmental entities, especially with prominent federal agencies such as the National Park Service and the National Marine Fisheries Service. This early attitude from FERC reflected heavily on the rest of the dam removal negotiation, showing advocates that political receptivity to policy change was very low within the main governmental institution presiding over the case.

Another issue affecting political receptivity was the differing perspectives on the costs of maintaining the status quo. Typically, when the costs of the status quo are perceived as high, readily apparent, and agreed upon, the relevant actors are more receptive to the proposed benefits of change (Lowry 2003). In the case of the Elwha River, the rival advocacy coalitions could not agree on the costs of maintaining the status quo or the benefits of the proposal. While dam removal advocates declared the dams as obsolete, hazardous, and economically unfeasible, opponents felt they provided inexpensive, reliable, and renewable energy. While environmental activists protested the ecological effects of the dams on Elwha fisheries and ecosystems, opponents refuted these ecological claims and protested the potential loss of the 1,000 local mill jobs associated with the hydropower dams.

These unfavorable interactions between coalitions regarding the proposed policy change significantly reduced the likelihood of the dam removal proposal succeeding. Dam removal policy change advocates pursued restoration of the Elwha River under less than ideal conditions as the bitter conflicts forced a realization that traditional uses of rivers would not surrender quietly. The community infighting showed a lack of commitment and resolve in the region, which allowed the governmental agencies presiding over the case to default on their decision regarding the dam removal proposal.

While FERC remained unmoved during negotiations on the Elwha case, broader national legislations eventually forced the agency to consider a balance of social and ecological needs, rather than simply the economics of hydropower. This mandate inevitably forced a more participatory decision-making process in the Elwha case, however the inflexibility of FERC's past had already made its impact in the region, and Congressional intervention was still required to give dam removal any prospects on the Elwha River.

The shift of political venue from the Elwha region to Congress introduced a whole new factor of rigid congressional politics serving to further reduce political receptivity around the case. National politics indifferent to issues on the Elwha River repeatedly blocked funding for the dam removal project. Only the unending political pressure from the regional advocacy coalitions could influence acceptance in the Congressional process and cultivate increased political receptivity amongst this important policy venue presiding on the Elwha. This pressure led to the *Elwha River Ecosystem and Fisheries Restoration Act* by Congress as the last resort to resolve conflict among the various coalitions in the Elwha case. Dam removal advocates showed that they would not be satisfied with anything less than removal of the two dams. It was this focused and committed resolve throughout the two decades of political obstacles that finally influenced the political receptivity to policy change.

In terms of Physical Complexity, the Elwha River Dam Removal proposal, although simple in principle, consisted of the unprecedented engineering task in removal of the two large hydropower dams in the protected setting of the Olympic National Park. With no prior dam removal of similar size to compare, the perceived physical complexity of this proposal was very high amongst fearful residents. The physical realm of dam removal can be difficult to understand as it involves engineering, fishery ecology, and legal measures. This caused many to oppose the project on the sheer belief that dam removal on this scale could not be done. Furthermore, the dam structures and reservoirs had been in place for nearly 100 years and many opponents simply could not envision the river without them.

Looking at the extensive list of agencies and smaller actors who held prominent roles over the years of dam removal negotiations, the dimensional complexity inherent to the various parties involved was also very high. This aspect of dimensionality became a significant issue as the dam removal proposal suddenly put into question many of the subsystems that traditionally governed the Elwha River. The Elwha River had been historically managed by a particular system of resource users that heavily promoted the function of hydropower. With the onset of calls for dam removal, a flood of new participants touting dramatic new policies overwhelmed this existing management system. This increased public participation caused friction and hardening amongst the traditional users of the Elwha River resources, but ultimately contributed to the transformation of these rigid tradition-bound institutions. The physical complexity of the Elwha dam removal, both in terms of the scale of the dams and the dimensionality of the agencies and actors involved, significantly delayed the project, however could not fully prevent fundamental policy change.

A surface reading of the policy change process in the Elwha case suggests that a lack of political receptivity combined with high physical complexity would have prevented fundamental policy changes, such as dam removal, from occurring. While these factors of receptivity and complexity created sustained conflict between advocacy

coalitions, the perseverance and collaboration of enough important actors eventually fostered sufficient political receptivity to overcome the high physical complexity. The success of this dam removal project through an exhausting political process shows that fundamental policy change in river management can occur, even in circumstances of unforgiving, tradition-bound coalitions. The dam removal on the Elwha River is a significant milestone, which indicates the broad changes occurring in United States river management. The policy change achievements in this case offer the opportunity to extract relevant policy lessons for future dam removal proposals in the country.

8.2 Policy Lessons from the Elwha River Dam Removal Case

The fundamental shift in policy resulting in the dam removal on the Elwha River illustrates the transformation in river management in the United States. When first proposed during the FERC licensing in 1976, the idea of dam removal on the Elwha River was considered extreme and irrational. This response hints of the larger sentiments in river management at the time. Nearly 40 years later, as the dams are now being removed, the project is widely celebrated as a symbolic achievement. The efforts of dam removal advocates on the Elwha River persevered through the early political adversity and gradually brought acceptance to the project.

This success on the Elwha River has bolstered the larger river restoration cause, and elicited visions of restored, free-flowing rivers across the country. However, this has been tempered by the reality that continued efforts for policy change in river management are necessary. While the Elwha River Dam Removal stands as a beacon for river restoration, it also provides more realistic, albeit less glamorous, policy lessons regarding the implications of congressional intervention in dam removal proposals, and the need for reforming hydropower dam licensing procedures in the Federal Energy Regulatory Commission. This project served as a milestone for testing and overcoming many unprecedented policy hurdles. It gives unique insights as the first and only dam removal proposal to be presided on by the United States Congress, and as one of the longest and most contentious hydropower dam licensing cases in the Federal Energy Licensing Commission. This section will conclude the thesis with policy lessons in these two arenas.

8.2.1 Dam Removal through Settlement

It was long recognized by many stakeholders in the Elwha case, that litigation through FERC's often biased licensing procedure would not be able to provide a workable solution. The stark divisions already present in the region were exacerbated by the court battles involved in FERC's licensing process, making consensus building towards a solution nearly impossible. Embroiled in this legal controversy without guidance from consistent FERC policy, the dams could potentially have been left intact indefinitely.

Therefore, the parties involved in the licensing proceedings, eventually including FERC, favored Congressional intervention and a negotiated government settlement to solve the situation. Congressional buyout of the dams came to represent an agreeable solution for all parties, and was seen as an important interagency cooperation and public-private partnership. The Congressional monetary settlement was ultimately the principal factor in bringing fundamental policy change and dam removal. It provided a clean way out for the dam owners and a sense of relief for river advocates seeking change from the unsympathetic private hydropower operations and the rigidity of FERC.

For many aging hydropower dams with expired FERC licenses, the significant safety, environmental and economic concerns make relicensing of the dam unreasonable and settlement towards dam removal the most scientifically rational and cost effective policy option. The lesson of the Elwha may help agencies and actors involved in these negotiations come to a settlement sooner and allow for time-sensitive important restoration projects to commence.

The settlement option on the Elwha River, involved Congressional buyout of the dams for \$29.5 million. While this settlement was widely seen as the only solution to the Elwha River dam removal dispute, it is questionable whether this expensive decision was truly the best-case scenario for the Elwha case. Although many applauded the strong Congressional action, others claimed it set a terrible precedent for future dam removal proposals, as private hydropower dam owners could now supposedly delay negotiations and hold out until a massive federal government payment. In retrospect on the Elwha case, this proved to be rather accurate.

The years of dispute within the communities of the region led the private owners of the Elwha dams to separate themselves from negotiations. Many now claim that the dam owners recognized the growing call for Congressional intervention, saw the potential for a buyout offer, and so continued to assume this position of non-negotiation. The potential for settlement became a dangerous bargaining card held by the private hydropower dam owners looking to reap the highest payout for their expired dams. This divisive political maneuvering obviously saw congressional buyout of dams as providing the clearest and most profitable exit strategy.

The politically and financially costly government settlement option cost \$29.5 million of national taxpayer funds paid directly to a private hydropower company, who had already been collecting substantial profit on the dams for decades. As the Elwha Dams did not meet modern environmental standards and were set in a protected National Park, many dam removal advocates felt, in principle that the dams were not legal in the first place, and rather than a victory for the dam owners through a government bailout, they would have liked to see the licensing fight play out in court.

Another issue associated with the Congressional intervention in the Elwha case stems from the volatility of changing dam removal negotiations from local contexts to unreliable national political venues. As debate over the Elwha moved from the Pacific Northwest region onto the national stage, some saw this as a triumph legitimizing the importance of the Elwha River, while others recognized the political instability of Congress as potentially debilitating for the dam removal project. Suddenly the debate over the Elwha was out of the hands of local decision makers and into the hands of national policy. The United States Congress is perhaps defined by the greatest degrees of high political complexity and low political receptivity. The likelihood of fundamental change and dam removal occurring through this political venue was extremely slim. When Congress passed the 1992 Elwha River Act authorizing purchase of the dams, it appeared to set the stage for the simple purchase and removal of the dams, causing many to believe the dispute on the Elwha River was over. However, bringing this once local issue into volatile national politics held up funding of the project for another 20 years.

Originally many Congressmen had supported the Elwha Act as a valiant solution to a difficult local situation. However, soon after passing of the *Elwha River Ecosystem and Fisheries Restoration Act*, congressional elections in 1994 changed the balance of congressional power to a new conservative ideology of fiscal austerity and limited governmental spending. The budget realities in the cost of the project caused many to suddenly reverse their stance and oppose dam removal. Funding for the Elwha Dam Removal project now had to compete with the economic needs of parks, forests and wildlife nationwide.

This changed the course of the dam removal project to a debate over whether the entire nation was responsible for the dams and expected to pay for the restoration of a remote river in Washington. Strong national political forces supported both sides of the cause, but the process then became based on arbitrary political ideology. Only the insistence of local stakeholders brought Congress to eventually foster some interagency collaboration and garner enough support to allocate funding for the Elwha, and begin the dam removal.

The original congressional disregard for the Elwha highlights the unreliability of a national politically driven approach to solving important ecological issues. These issues show that while government settlements in dam removal negotiations can be powerful for shifting authority away from FERC and traditional private hydropower resource use of rivers and for putting the public back in charge of rivers, this option can also be risky in terms of financial cost and political time.

8.2.2 Policy Lessons for Alternative Hydropower Licensing Procedure

The FERC hydropower dam relicensing procedure necessarily involves a long and complex process, however, it can lead to costly litigation, extended conflict, and delayed implementation of upgrades and environmental controls on dams. In the Elwha case, the intervention by Congress represented a decision to avoid the traditional FERC licensing policy process, which would have surely led to costly and time consuming litigation. By overriding FERC's authority and taking the process out of FERC jurisdiction, Congress essentially undermined the respect and validity of the FERC agency's procedures. This sent out a strong message for the reform of the ineffective FERC hydropower dam licensing process.

Since the decision on the Elwha, many institutional actors have collaborated on efforts to revise FERC licensing procedures for hydropower operations and reduce the necessity for Congressional intervention in future cases. Although FERC has now adopted policies regarding dam decommissioning and removal, it has repeatedly shown that it continues to retain biases toward hydropower dams and private energy companies, which greatly impedes consideration of, dam removal and river restoration. FERC's lack of consistent policies has created significant controversies and prevented dam removal from being fully achieved, even in reasonable straightforward situations.

Rather than the stated structural, safety and ecological scientific analysis of dams, FERC's relicensing process has been made into a biased political decision. What is fundamentally an ecological restoration tool; the concept of dam removal is burdened by FERC's traditional predisposition to the hydropower industry. Many pertinent issues around dam removal are still unfamiliar territory for FERC, which has failed to incorporate new readily available scientific dam removal information. This exposes the need for comprehensive reform of FERC policy and of the need for a separate independent commission to specifically review and recommend dam removal within FERC jurisdiction.

For a more balanced appraisal of dam removal and river restoration proposals, the public needs to be better included in the FERC licensing process. Early identification of stakeholder resource interests and participatory decision-making amongst these interests can create efficient public private partnerships around dam removal cases. Advocates in the Elwha River case worked hard to create public involvement through collaborative arrangements of diverse stakeholders, which eventually fostered enough political receptivity for the adoption and implementation of the dam removal proposal. FERC's licensing process should build off this example set on the Elwha River.

The development of alternative licensing processes in FERC could better describe the importance and value of non-power resources, such environmental, recreational, and cultural resources of rivers. In these descriptions of river resources, rather than a focus on historical traditional management, identifying anticipated future resources uses would better incorporate ecological restoration goals. FERC jurisdiction over hydropower dams has a much larger effect than purely on hydropower operations, and better determination of the existing prevalence and condition of those river resource elements would significantly avoid conflict over dam removal proposals. It could also better recognize the uncertainties and variables associated with the economics of the specific hydropower projects as to not inflate their perceived importance. Additionally, being realistic about the differences in existing short and long-term economic conditions of dams could make for smoother dam removal proposals.

Various NGO's have recognized this issue in FERC and are attempting to revise traditional hydropower licensing procedure through alternative licensing processes, most notably, the *Hydropower Reform Coalition*, which through a collaborative effort of over 130 national, state and local organizations, has influenced FERC proceedings and forced the concept of dam removal to gradually permeate FERC decision making processes.

As FERC hydropower dam licenses continue to expire, this represents an incredible opportunity to review the licensing process. While the historical tradition of FERC would promote hydropower, it is now one of the few agencies that holds national significance for regulating dams and should therefore responsibly wield its power to impose smarter regulations on dams, and in certain cases, revoke dam licenses, remove dams and reverse the harmful effects to rivers. The development of alternative licensing processes offer considerable potential for producing fundamental changes for river restoration, which will be of the utmost importance as more hydropower dam licenses expire.

9.0 Conclusion

As free-flowing rivers have become scarce, the value of natural river resources has expanded. Once thought of as symbols of development and modernization in the United States, dams now commonly symbolize, not progress, but ecological damage. This is a profound shift in social discourse, which occurred over a remarkably short span of time. People are becoming cognizant of the real value of rivers, and are now drawn to the concept of dam removal, not only for its strong set of ecological ideals, but also in its tangible, visible freeing of a trapped river. This symbolic value of dam removal in the redemption of nature is invaluable.

The transformation in river management is underway, evident by the 1 billion dollars now spent annually on river restorations and dam removals in the United States (Bernhardt 2005). This transformation is being experienced through the cumulative affects of influential river restoration cases such as the Elwha River Dam Removal project. The fundamental policy change on the Elwha River came from the exhaustive efforts of advocacy coalitions pioneering the concept of dam removal in the region. This monumental undertaking on the Elwha River holds great significance to the broad transformation in river management.

In this thesis, description of the Elwha River case and exploration of the larger emergence of the dam removal concept contributes to the discourse on river management. Through compiling the fragmented literature on the evolution of dams and dam removal, and gaining valuable insights from interviews and observation, this research illustrates the significant transformation in river management currently taking place in the United States. Contribution to the study of the transformation river management also acted as vital background to the policy oriented aims of the thesis.

Analysis of the phenomenon of policy change through the lens of key policy theories, such as the Advocacy Coalitions concept, reveal significant factors in the process of policy change, particular to river management in the United States. Critical aspects of political receptivity and physical complexity were isolated and analyzed in the Elwha River Dam Removal case. This theoretical application served to clarify how policy change occurred in the Elwha River case and what were the central institutional actors in the change. Findings from this analysis led to policy change lessons for advancing dam removal proposals, namely the issues involved in government settlements, and the need for alternative licensing procedures in FERC.

In the evolution of river management, the concept of dam removal has developed case-by-case, dam-by-dam, through scattered policies and projects. With the increasing recognition of the social and ecological importance of rivers, and the magnitude of river restoration that must take place to respond, it is now evident that the policies around dam removal must be examined. Reestablishing essential ecological components and interactions in rivers through dam removal is possible, however, it requires more than just physical ecological projects, but also changing long term environmental policies that affect rivers. The policy process must be streamlined, political responsibility must be organized and funding must be allocated to this important restoration cause.

For the concept of dam removal to continue producing extensive river restoration results, the movement needs a footing in lasting policies and political venues. As thousands of dams reach the end of there licenses and their environmental impacts continue to mount, the opportunity and need to integrate dam removal into river lasting river management policy is now.

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