



OKANAGAN AGGREGATE POTENTIAL PROJECT

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KEYWORDS: Aggregate potential, Okanagan, sand and gravel.

INTRODUCTION

Aggregate is defined as a mass or body of rock particles, mineral grains, or a mixture of both. A working rule is that aggregate with a water absorption value of less than 2% will provide a good quality product, whereas that exceeding 4% may not (Collis & Fox, 1985). With this in mind, not all unconsolidated material can be used as good quality aggregate.

The future exploitation of sand and gravel in favourable deposits may be increasingly restricted as a result of growing public concern with environmental issues and expanding urbanization. Pits, once peripheral to populated areas, are now being incorporated into the ever encroaching development (Photo 1). There is a danger that much of this expansion may occur in areas overlying potential aggregate resources, thus sterilizing them (Photo 2). Paradoxically however, all development is dependent upon aggregate

production since 95% is used in the construction industry. Of this amount about half goes into building construction and the other half into public works (R. Poulin *et al.*, 1993).

Production is on a demand basis as there is very little inventory accumulated. In anticipation of the burgeoning demand for aggregate and the well ordered production of sand and gravel, a documented inventory for the province is essential, with the intent of delineating and forms and their aggregate potential for future exploitation.

PREVIOUS STUDIES

Past work relevant to this study was reported by Nasmith (1962), Fulton (1965) and Hora (1988).

Studies undertaken by the Ministry of Energy, Mines and Petroleum Resources circa 1985, the Ministry of Environment, Lands and Parks circa 1984 and the Ministry of Transportation and Highways have been compiled into a series of unpublished maps (n.d.), by the Geotechnical and Materials Engineering Branch of the Province of British Columbia, Ministry of Transportation and Highways.



Photo 1. Urban encroachment onto pre-existing gravel operation.

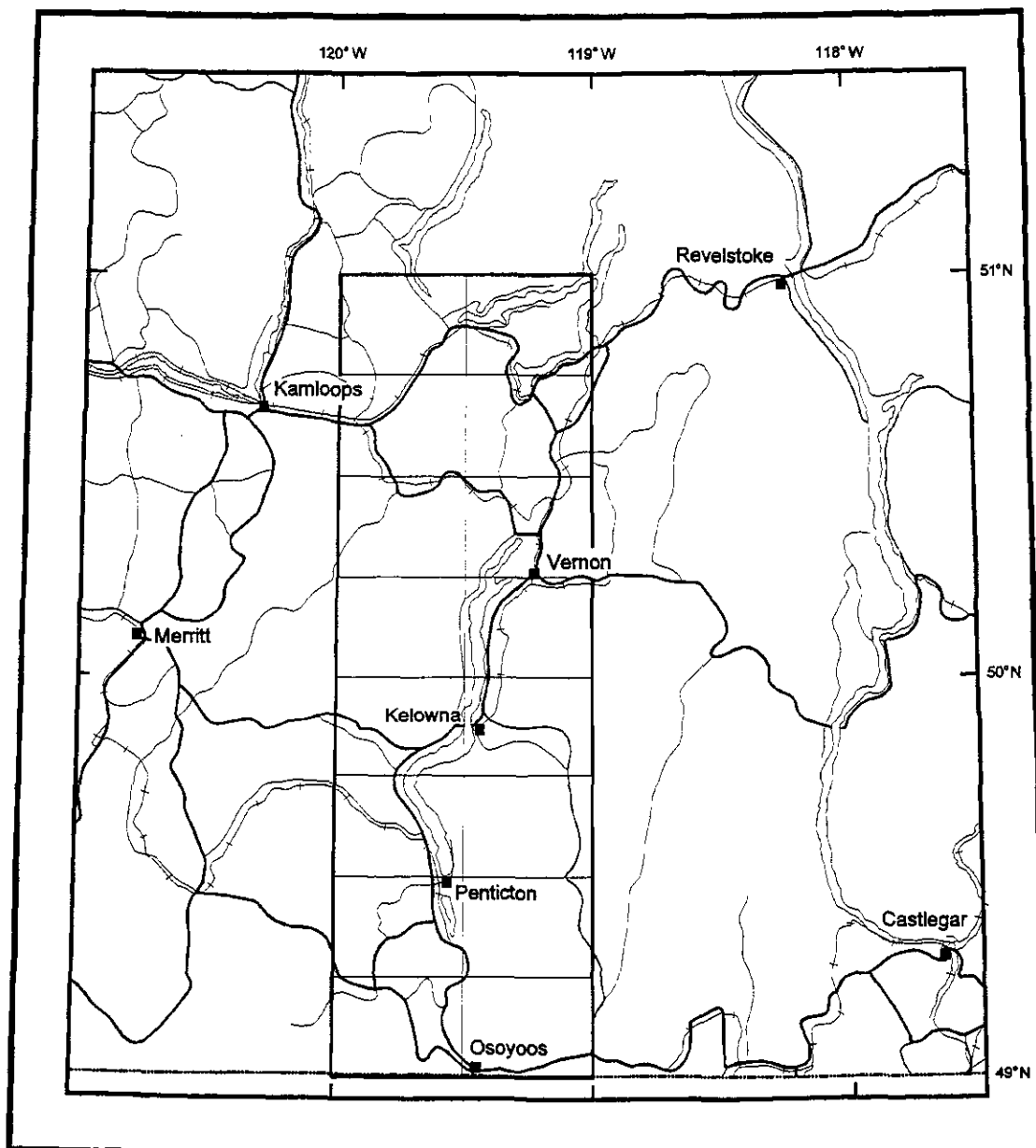


Figure 1. Location of study area in the southern interior of British Columbia.

PROJECT OBJECTIVES

The project objective was to examine existing resources and known occurrences and establish potential aggregate resources for the Shuswap and Okanagan Valley. This would be accomplished by compiling previous work, field observations, and air-photo mapping.

AGGREGATE POTENTIAL MAPS

The primary objective is to produce a series of aggregate potential maps for the study area. Pits that were previously located on topographic and aggregate inventory maps will be used together with new field data and polygons

from soils and terrain maps to provide a database from which the potential maps will be produced at the 1:50 000 scale.

This information is in accordance with the aims identified at a workshop in 1995 (Bobrowsky *et al.*, 1996b). A case study example was completed last year for the Prince George area (Bobrowsky *et al.*, 1996a) and is now available.

METHODOLOGY

The project began, by documenting sites identified from license permits, Ministry of Transportation and Highways location maps, topographical maps, aggregate inventory maps for the Geological Survey Branch (*i.e.* Matheson *et al.*, 1996), and air-photos.



Photo 2. Sterilization of aggregate resources.

LOCATION OF STUDY AREA

In 1996, a survey was initiated in the Shuswap and Okanagan areas where population expansion has stressed present aggregate resources. This area lies within the southern interior physiographic region in southern British Columbia (Figure 1). Sixteen map sheets were covered; 82 E/3, 4, 5, 6, 11, 12, 13, 14, and 82 L/3, 4, 5, 6, 11, 12, 13, 14, forming a corridor 80 kilometres wide and 200 kilometres long from Shuswap Lake south to Osoyoos.

PHYSIOGRAPHY

The northeastern part is dissected by narrow, generally steep-sided glacial valleys, trending north-south and east-west, dominated by Shuswap Lake (Figure 2). The central and southern portion is traversed by a long narrow valley containing Okanagan Lake, Skaha Lake and Osoyoos Lake.

GLACIAL HISTORY

The south and central areas of B.C. were glaciated prior to and throughout the Wisconsinan (Ryder *et al.*, 1991). Glaciation in the southern Okanagan formed part of the Cordilleran Ice sheet that flowed southward along the Okanagan valley, a major physiographic depression in the region. Ice thickness reached up to 2000 metres in the valleys and hundreds of metres atop the intermontane plateaus. Thus the surface gradients of the ice sheet were very low and not related to the rugged terrain beneath the ice. The Fraser glaciation reached a maximum in the Late Wisconsinan at about 14 500 to 14 000 years BP (Ryder *et*

al., 1991). This was followed by deglaciation that began before 13 500 years BP and was virtually complete by 11 500 years BP.

Deglaciation formed a series of erosional landforms produced by downwasting of the ice sheet rather than a large recessing ice lobe front (Ryder *et al.*, 1991). The deglaciation was marked by an emergence of the uplands and isolation of large masses of stagnant and ablating ice in the valleys, resulting in the formation of glacial lake Penticton as drainage was stopped by ice damming to the south. Deglaciation was rapid with high sedimentation rates attributed to: (1) climate deterioration, (2) glacial and meltwater erosion, and (3) rapid reworking of sediments (Ryder *et al.*, 1991).

Glacial landforms were controlled mainly by the topography of the area. Drift accumulated in the low-lying areas and valleys. Conversely, the bedrock knobs and plateaus were coated with a thin veneer of till. Recessional landforms are found mainly in the low-lying parts of the plateaus and in the valleys. These include eskers, kame terraces, kettles, and moraines formed in a proglacial/ice-contact depositional environment.

Outwash consists of glaciofluvial (F^G), glaciolacustrine (L^G), and glaciomarine (W^G) sediments. Glaciofluvial sediments are composed mainly of sand and gravel that accumulated in subaerial and subaqueous environments.

FIELD WORK

Pits identified in the study area were photographed, and documented under the following notations: name of pit, unique identity number and license, licensee or operator, and development status. This included measuring pit dimensions and exposed sections that would allow facies interpretation, depositional history, and quarry type. A hand-held global positioning system and the N.T.S. maps were used to accurately define the pit location which was then plotted using UTM coordinates on the N.T.S. maps and soil maps for the Okanagan Valley.

DATA COMPILATION

A database was compiled consisting of the licensing, field observations, air-photo interpretation, delineation and identification of landforms. The aggregate pits will be digitized as points on the sixteen map sheets. This information will later be combined with water well-logging and previous geotechnical reports to create attributes for each pit in ARC-info, the G.I.S. software used for plotting the data.

RESULTS/OBSERVATIONS

Field studies lasted over a five week period in June and July, 1996 and of the 308 known sites, 267 were examined. Due to time and financial constraints, the remaining 41 sites

were evaluated by air-photo interpretation. The pits examined varied from borrow pits (Photo 3) that displayed 30% fines by volume, to large scale operating sand and gravel pits (Photo 4), and revegetated and reclaimed pits to housing developments in former pits (Photo 5).

DISTRIBUTION OF AGGREGATE RESOURCES

GEOGRAPHIC LOCATION

The demand for aggregate is greatest around the more densely populated areas where the need for sand and gravel reflects the active construction industry. Numerous pits in the Shuswap area and near settlements such as Salmon Arm (82 L/11), Vernon (82 L/6), Kelowna (82 E/14), Penticton (82 E/5), and Keremeos (82 E/4) form the majority of active aggregate extraction operations.

DEPOSIT, LANDFORM, AND SOIL TYPES

Aggregates were derived mainly from meltwater sediments that form in a proglacial environment. Fluvial sediments (i.e. fan, delta, and river deposits) form only thin deposits of unconsolidated material (Fulton, 1972) and represented less than 9% of the deposits with aggregate pits. Glaciofluvial deposits (meltwater sediments) account for 80% of the aggregate pits and are located mainly in and along the low-lying valleys. Of these glacial deposits,



Photo 3. Borrow pit with greater than 30% fines.

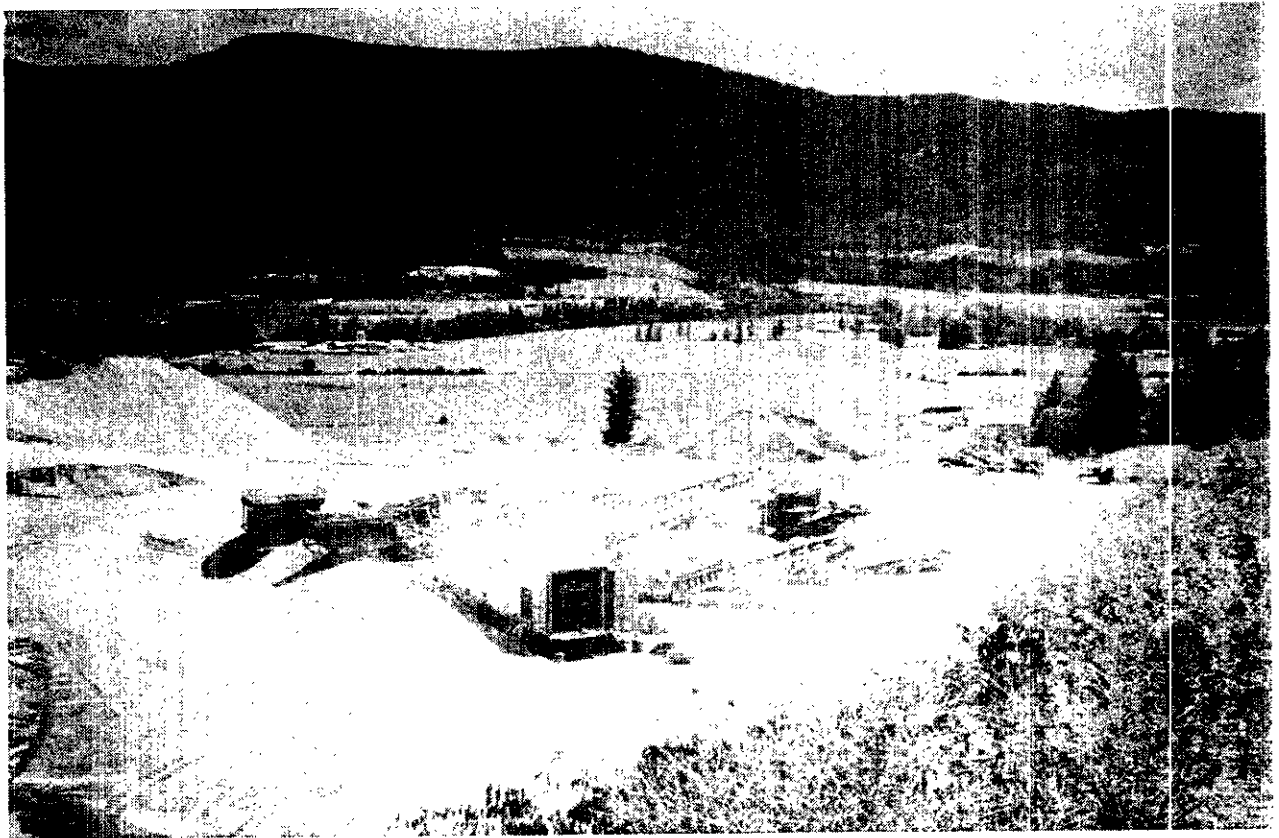


Photo 4. Large operating aggregate pit.

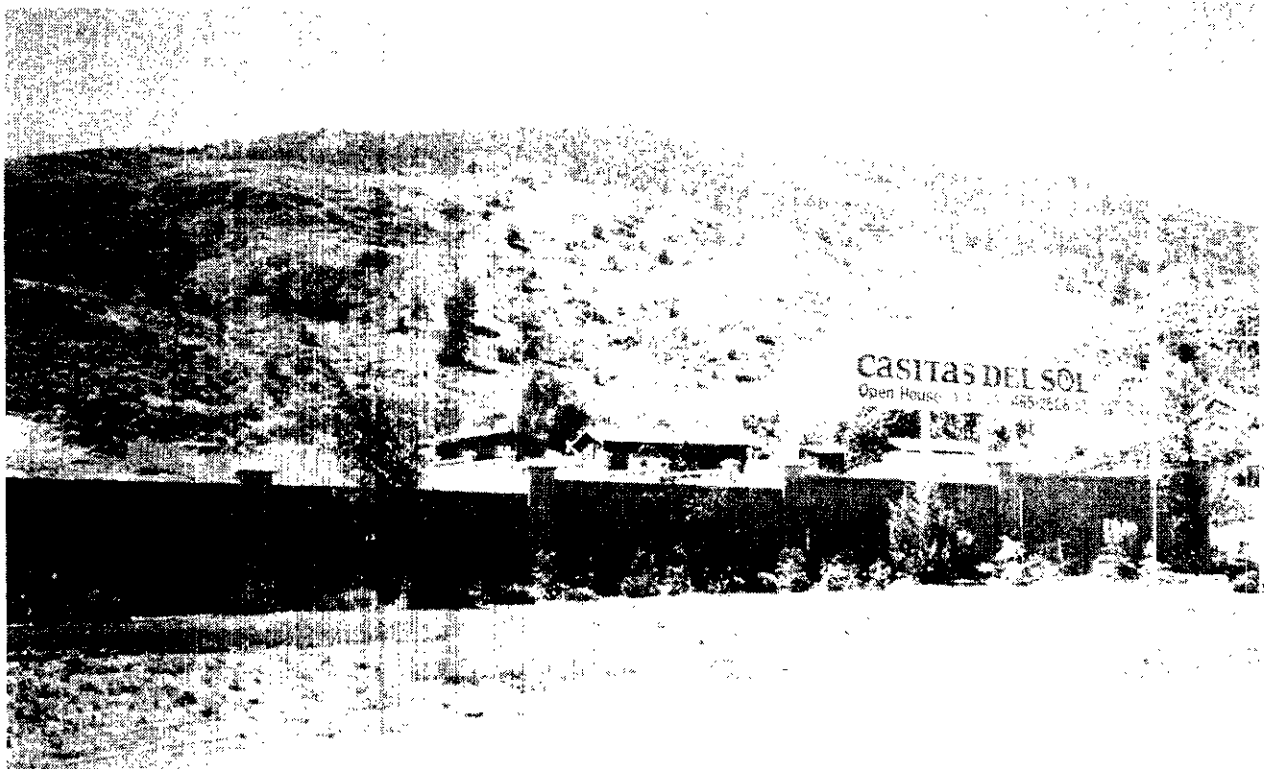


Photo 5. Subdivision in old pit location.

glaciofluvial fans, terraces, and kame terraces accounted for approximately 75% of the total pits under study. These sediments were most likely deposited during the deglaciation (Fulton, 1972) following the Fraser glaciation.

Landforms for each pit were derived from their location on Ministry of Environment soil maps for B.C. These correspond to deposit types identified at many of the pits. However, this is not always the case suggesting some ambiguity in the interpretation and boundaries of the labeled polygons.

Soil types have been correlated between soil maps using characteristics such as: vegetation, texture, landforms, soil drainage, moisture content, slope, elevation, bedrock, and soil taxonomy. Consistently, aggregate pits were found in coarse-grained glaciofluvial landforms with good drainage and moderate slopes throughout the Okanagan and Shuswap area.

CONCLUSIONS - DISCUSSION

LOCATING FUTURE DEPOSITS

Future deposits should be sought after in the low-lying areas where glaciofluvial deposits persist. When urban development and exploitation have limited the aggregate potential for these areas, smaller, but similar deposits located adjacent to the large valleys could be used in the future. These landforms will be located on the aggregate potential maps and with ground truthing and more detailed air-photo interpretation, will allow accurate identification of future aggregate resources.

VALUE OF AGGREGATE PROGRAM

There will always be a demand for aggregate and consequentially it is essential to have a well documented inventory for future use in general development planning, construction, and the resulting infrastructure of transportation networks. Thus, an inventory of aggregate resources in areas of British Columbia should be completed so that they may be used in a most effective manner.

ACKNOWLEDGMENTS

The authors would like to thank the many owner/operators of gravel pits who kindly allowed access to their operations and to J.A. Valentinuzzi and B.E. James of the Ministry of Transportation and Highways for information supplied from their gravel management support system.

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